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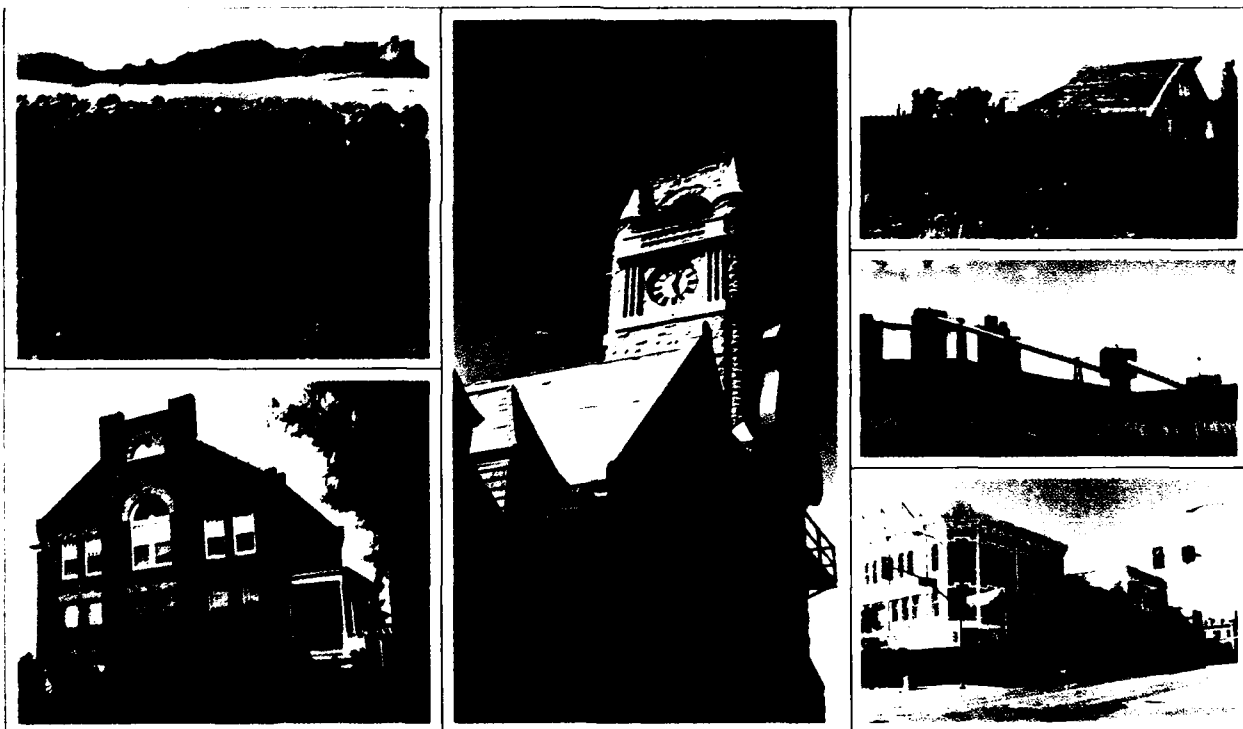


Department of the Air Force

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# ENVIRONMENTAL PLANNING TECHNICAL REPORT



## ENERGY

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January 1984

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**Air Force  
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FINAL ENVIRONMENTAL PLANNING  
TECHNICAL REPORT

ENERGY RESOURCES

January 1984

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## PREFACE

The President has directed that the Air Force deploy the Peacekeeper missile system at a location near F.E. Warren Air Force Base (hereafter F.E. Warren AFB), close to Cheyenne, Wyoming. The Peacekeeper system (formerly known as the M-X system) is an advanced, land-based intercontinental ballistic missile. The plan calls for the replacement of 100 existing Minuteman III missiles with 100 Peacekeeper missiles. Existing missile silos will be used, and there will be very little structural modification needed. Missile replacement will occur within the two squadrons (of 50 missiles each) located nearest F.E. Warren AFB, the 319th and 400th Strategic Missile Squadrons. Peacekeeper deployment will occur between 1984 and 1989.

An environmental impact statement (EIS) was prepared for the Proposed Action as outlined above. Information contained in the EIS is based upon environmental information and analysis developed and reported in a series of 13 final environmental planning technical reports (EPTRs). This volume is one of those reports. The 13 resource areas are:

- o Socioeconomics (employment demand, housing, public finance, construction resources, and social well-being);
- o Public Services and Facilities;
- o Utilities;
- o Energy Resources;
- o Transportation;
- o Land Use (land use, recreation, and visual resources);
- o Cultural and Paleontological Resources;
- o Water Resources;
- o Biological Resources;
- o Geologic Resources;
- o Noise;
- o Air Quality;
- o Jurisdictional.

## ENERGY RESOURCES

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## **INTRODUCTION**

## 1.0 INTRODUCTION

This final environmental planning technical report (EPTR) is a companion document to the energy resources section of the final environmental impact statement (FEIS) for the Peacekeeper in Minuteman Silos project. It provides data, methodologies, and analyses which supplement and extend those presented in the FEIS.

This final EPTR consists of six major sections. Section 1.0 provides an overview of the Peacekeeper in Minuteman Silos project and a description of energy resources and their elements.

Section 2.0 presents a detailed description of the environment potentially affected by the project. It includes a capsule description of the environmental setting (Section 2.1) and project requirements (Section 2.2). Section 2.3 defines the Region of Influence and Area of Concentrated Study for the resource. Section 2.4 (Derivation of Data Base) follows with a discussion of the literature sources, group and agency contacts, and primary data which provide the data base for the report. Section 2.5 describes analytic methods used to determine existing environmental conditions in the Region of Influence. Detailed analyses of the existing environment, broken down by constituent elements of the resource, follow in Section 2.6.

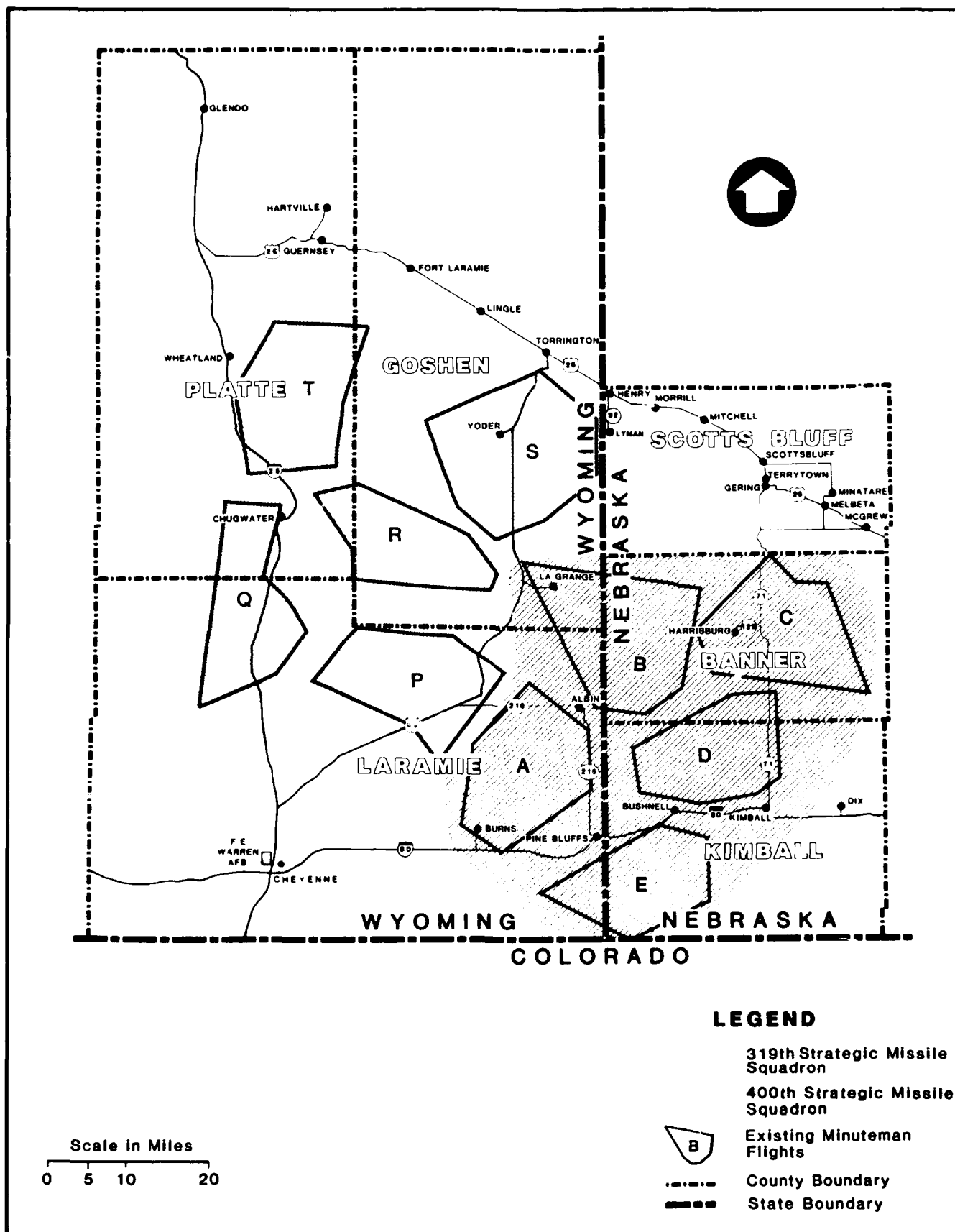
Section 3.0 describes environmental consequences of the Proposed Action and its project element alternatives, the No Action Alternative, mitigation measures, and unavoidable impacts. It contains detailed definitions of each potential level of impact (negligible, low, moderate, and high) for both short-term and long-term impacts. Beneficial effects are also discussed. Definitions of significance are also included. Methods used for analyzing future baseline and project impacts are described, as are assumptions and assumed mitigations. Additional mitigation measures to reduce project impacts are also described.

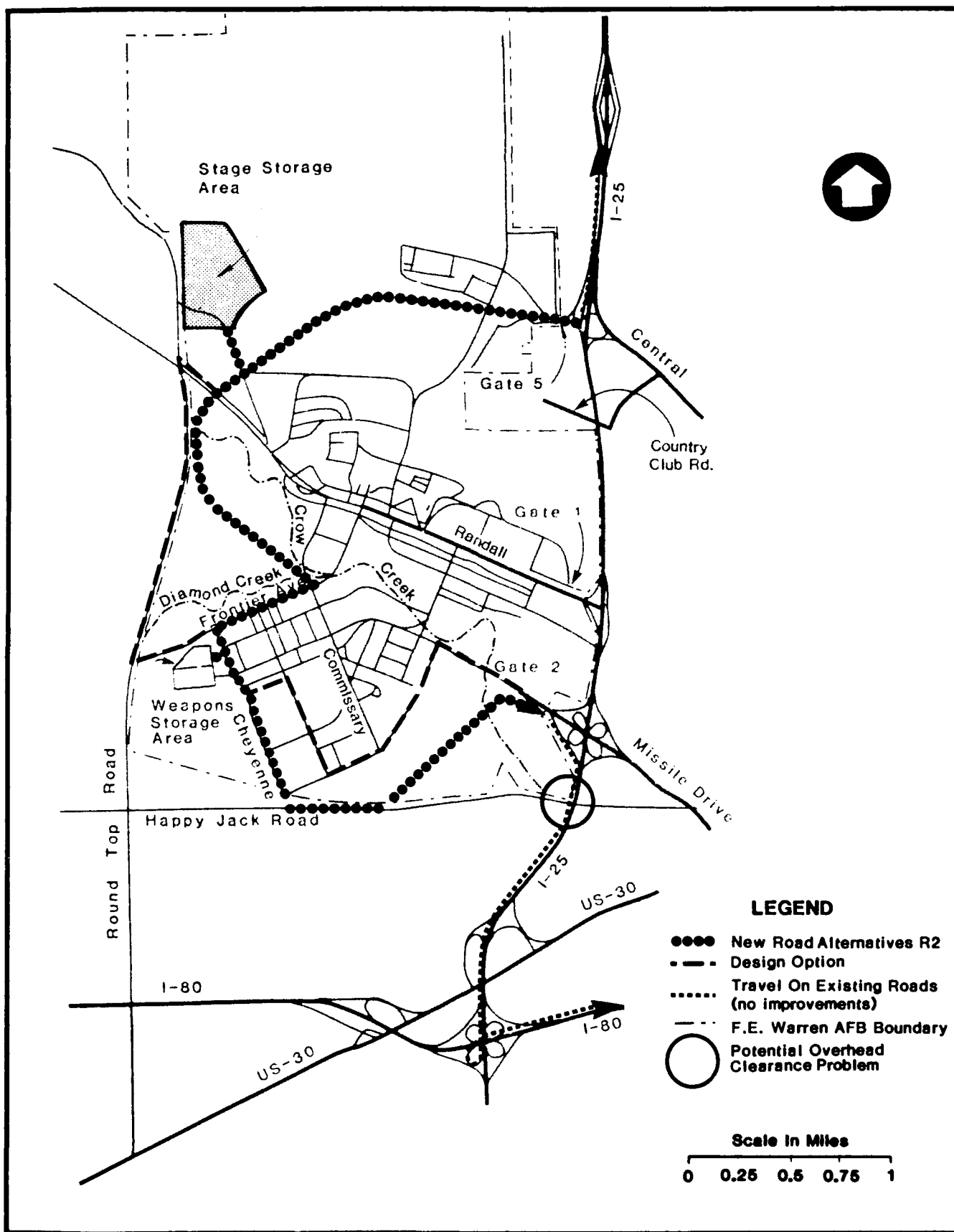
Sections 4.0 (Glossary), 5.0 (References), and 6.0 (List of Preparers) conclude the EPTR.

### 1.1 Peacekeeper in Minuteman Silos

The Peacekeeper system, which the Air Force plans to deploy within the 90th Strategic Missile Wing at F.E. Warren Air Force Base (AFB), Wyoming, is an advanced land-based intercontinental ballistic missile system designed to improve the nation's strategic deterrent force. Deployment of the Peacekeeper calls for replacement of 100 existing Minuteman III missiles with 100 Peacekeeper missiles. Missile replacement will occur in the 319th and 400th Strategic Missile Squadrons, located nearest F.E. Warren AFB (Figure 1.1-1). The Deployment Area covers parts of southeastern Wyoming and the southwestern Nebraska Panhandle.

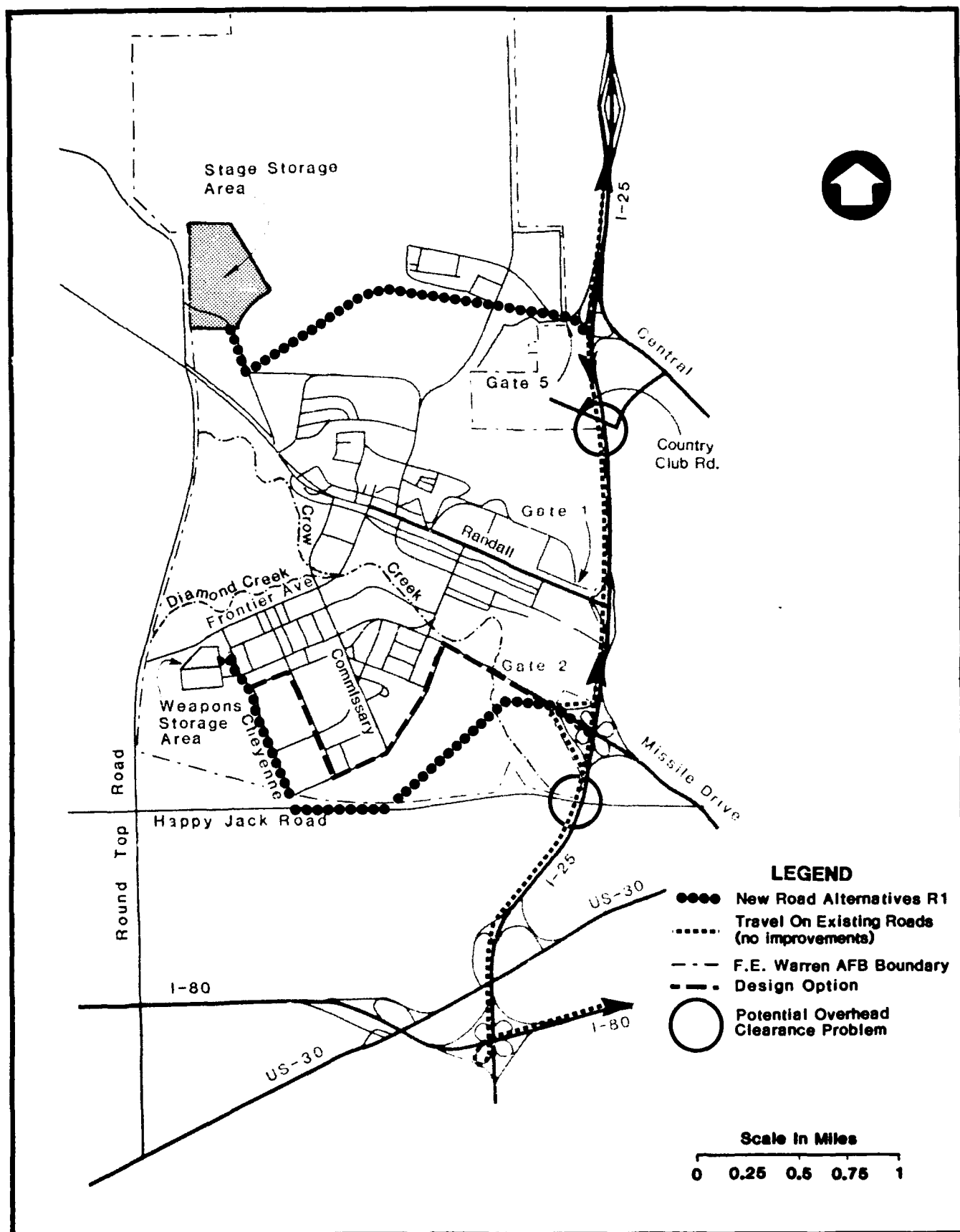
Construction at F.E. Warren AFB will occur between 1984 and 1986. Fourteen new buildings will be constructed, and modifications or additions will be made to 11 existing buildings. Approximately 400,000 square feet of floor space will be built or modified. A new road configuration, to be selected from three alternatives, is proposed to link Peacekeeper facilities onbase and to provide improved access to or from the base (Figures 1.1-2, 1.1-3, and 1.1-4).





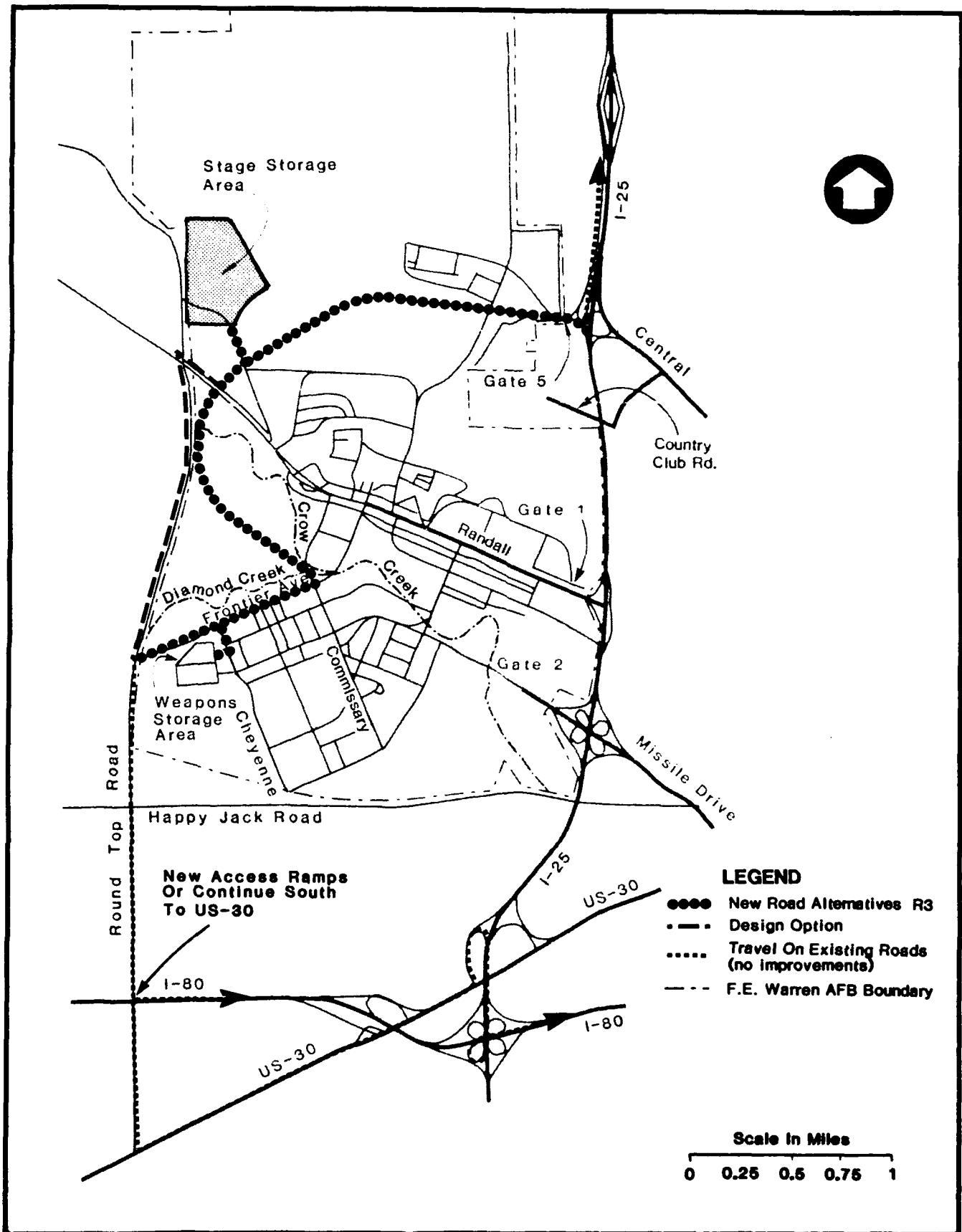
**NEW ROADS AT F.E. WARREN AFB:  
PROPOSED ACTION R2**

**FIGURE NO.  
1.1-2**



NEW ROADS AT F.E. WARREN AFB:  
ALTERNATIVE R1

FIGURE NO.  
1.1-3



**NEW ROADS AT F.E. WARREN AFB:  
ALTERNATIVE: R3**

**FIGURE NO.  
1.1-4**

Work in the Deployment Area will take place between 1985 and 1989. Many of the access roads to the Launch Facilities will be upgraded. Bridge clearance problems will be corrected, and some culverts and bridges may need to be upgraded. Below-ground modifications will be related to removal of Minuteman support hardware, insertion of a protective canister to enclose the Peacekeeper, and installation of communications systems and support equipment.

A total of 11 alternatives have been chosen as candidate routes for communication connectivity between Squadrons 319 and 400 (Figure 1.1-5). Five routes will be selected for installation. Total buried cable length will range from approximately 82 to 110 miles, depending upon final route selections.

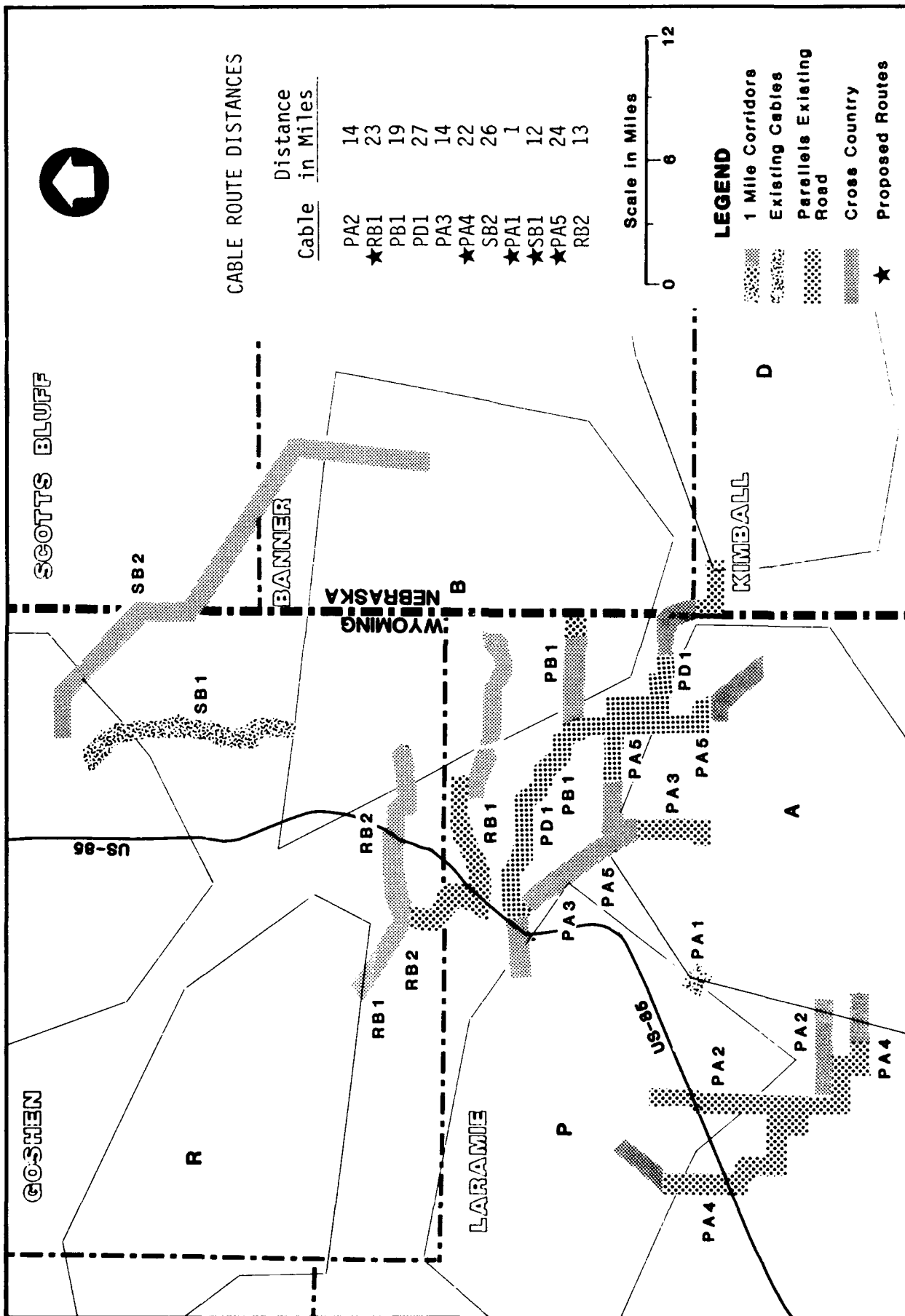
Under the Proposed Action two dispatch stations would be established, one each in the northern and eastern portions of the Deployment Area. Although actual locations have not been selected, Chugwater, Wyoming and Kimball, Nebraska are representative locations analyzed in the Final Environmental Impact Statement and in this EPTR. Dispatch stations would be not more than 5 acres in size and would be used for the temporary open storage of equipment and material. One or more buildings would also be present at each site for contractor use as office space. All dispatch stations would be removed prior to project completion. In addition to the Proposed Action, two alternatives are considered in this environmental impact assessment:

- 1) One dispatch station only, in the eastern part of the Deployment Area; or
- 2) No dispatch stations.

Two options have been identified for resurfacing Deployment Area roads. Surfacing Option A involves gravel upgrades of 252 miles of existing gravel roads and the paving or repaving of 390 additional miles of gravel and asphalt roads. Surfacing Option B involves the paving or repaving of all 642 miles of gravel and asphalt roads listed in Surfacing Option A.

Direct manpower for construction, assembly and checkout, and operation of the system will peak during 1986 when an average of nearly 1,600 persons will be required. In 1991, following deployment, the remaining increased operational workforce at F.E. Warren AFB will consist of about 475 persons. Table 1.1-1 presents the average annual workforce, based on quarterly estimates for each year of construction.

Table 1.1-2 shows the average number of jobs including those which are considered to be filled by available labor; as well as those filled by weekly commuters and immigrants, on an annual average basis. In general, locally available labor will fill all the road and construction jobs.



ALTERNATIVE CABLE ROUTES

FIGURE 1.1-5

Table 1.1-1

PROJECT AVERAGE MANPOWER REQUIREMENTS BY YEAR<sup>1</sup>

Deployment Area	1984	1985	1986	1987	1988	1989	1990	1991
Construction	5	40	60	60	40	0	0	0
Assembly and Checkout	0	15	210	285	265	265	10	0
Operations	0	0	0	0	0	0	0	0
Defense Access Road	0	275	315	150	0	0	0	0
Subtotal	5	330	585	495	305	265	10	0
Operating Base								
Construction	100	630	70	0	0	0	0	0
Assembly and Checkout	40	130	525	555	515	510	22	0
Operations	0	130	415	490	500	500	475	475
Subtotal	140	890	1,010	1,045	1,015	1,010	497	475
TOTAL:	145	1,220	1,595	1,540	1,320	1,275	507	475

Note: <sup>1</sup> Estimates based on average quarterly employment.

Table 1.1-2

TOTAL JOBS, LOCAL AND REGIONAL HIRES, AND IMMIGRATION FOR  
THE EMPLOYMENT DEMAND REGION OF INFLUENCE

	1984	1985	1986	1987	1988	1989	1990	1991 and beyond
1) Total (Direct/ Indirect) Additional Jobs	250	2,400	2,675	2,550	2,025	1,825	650	590
2) Average Annual Local Hires	157	1,750	1,525	1,350	1,100	815	225	230
3) Average Annual Weekly Commuters	25	225	175	100	25	10	0	0
4) Average Annual Immigrant Workers	75	425	950	1,100	925	1,000	425	360
5) Unsuccessful Job-Seekers	30	185	180	150	165	110	70	0
6) Immigrant <sup>1</sup> Population	275	1,475	2,875	3,200	3,025	2,875	1,200	925

Note: <sup>1</sup> Includes immigrants, workers, and unsuccessful job-seekers.

As a result of the purchase of materials in the project area and the local expenditures of project employees, additional jobs will be created in the region. These jobs are estimated to number as follows:

Year:	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991 &amp; on</u>
Indirect Jobs:	105	1,180	1,080	1,010	705	550	143	115

Estimated materials and costs for the project, based on total project budgetary considerations, are shown by Standard Industrial Classification in Table 1.1-3.

A number of construction and support materials will be obtained from sources within the project area. Among the materials exerting a major influence on assessment of project impacts are aggregate (4.6 million tons), water (516 acre-feet), fuel (7.6 million gallons), and electricity (3.8 million kWh). In the case of water supply for construction, the Air Force will identify and, if necessary, obtain permits for the water or purchase existing water rights.

## 1.2 Description of Resource

Energy resources to be assessed in conjunction with the Peacekeeper in Minuteman Silos project include electricity, natural gas, petroleum products, and coal. These energy types account for the great majority of the energy consumed in the study area. The local distribution system for each energy type, regional transmission lines which supply these energy resources, as well as major energy sources outside the study area will also be included.

Table 1.1-3

ESTIMATED MATERIAL REQUIREMENTS  
BY STANDARD INDUSTRIAL CLASSIFICATION

<u>Industrial Classification</u>	<u>Estimated 1982 Dollars (1,000s)</u>
Fabricated Structural Metal	\$22,999
Unclassified Professional Services and Products	14,358
Cement and Concrete Products	10,862
General Wholesale Trade	8,890
Structural Metal Products <sup>1</sup>	11,983
Millwork, Plywood, and Wood Products <sup>1</sup>	3,941
Copper, Copper Products	3,902
Electrical Lighting and Wiring	3,871
Stone and Clay Mining and Quarrying	39,728
Stone and Clay Products <sup>1</sup>	2,955
Basic Steel Products	1,233
Heating and Air Conditioning Apparatus	1,525
Plumbing and Plumbing Fixtures	938
Petroleum Refining and Products	5,148
Material Handling Equipment	1,970
Sawmills and Planing Mills	1,478
Paints and Allied Products	1,478
Plastic Products <sup>1</sup>	1,478
Furniture and Fixtures	986
Structural Clay Products	986
General Hardware	986
Scientific Instruments	986
Rail Transport	986
Real Estate	986
Construction, Mining, and Oilfield Machinery	749
TOTAL:	\$145,402

Note: <sup>1</sup> Not included in other Industrial Classifications.

**2.0**

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## **AFFECTED ENVIRONMENT**

## 2.0      **AFFECTED ENVIRONMENT**

### 2.1      General

The project area is situated along the eastern edge of a region of the United States that is relatively well endowed with energy resources. Much of the electric supply to the area comes from hydroelectric generating plants in and adjacent to the Rocky Mountains and along rivers farther to the west. Vast deposits of coal in the Powder River Basin (just north of the project area) and elsewhere in Wyoming and Montana fuel several large coal generating plants which have been recently built. None of the local electric utilities in the project area generate their own power. Instead they purchase it wholesale from regional suppliers which operate these large power plants.

Most of the natural gas used in the project area is produced from nearby gasfields in Wyoming and Colorado. Due largely to its ready availability, 80 to 90 percent of the homes are heated by natural gas. Petroleum production and refining is also an important industry in the region. Overall, the region has been and will continue to be an important exporter of energy to the rest of the nation.

### 2.2      Project Requirements

Overall project requirements are outlined in Section 1.1. Requirements specific to the energy resource are as follows.

Energy requirements for the project fall into two major categories. Those required to either construct or operate the system are direct energy requirements. The indirect energy requirements are those resources needed to sustain the people (workers and families) who will move into the area as a result of the project.

The direct energy needs for the project are shown in Table 2.2.1-1. No coal or natural gas is required for project construction. Total electrical needs for construction are estimated to be about 40 percent of the increase in annual operating use of electricity once construction is completed. The post-construction increase in the annual amount of operational energy use at F.E. Warren AFB and the Deployment Area (DA) above 1982 levels, following construction, will be:

Electricity	14 percent
Natural Gas	1 percent
Petroleum Products	2 percent
Coal	12 percent

Table 2.2.1-1

## DIRECT ENERGY NEEDS FOR THE PROJECT

	Electricity (kWh x 10 <sup>3</sup> )	Peak Electrical Demand (KW)	Natural Gas (MCF)	(Thousands of Gallons)	Gasoline (Thousands of Gallons)	Diesel Coal (Tons)
Construction at F.E. Warren AFB	2,274	1,000	0	895	302	0
DA Construction	1,500	125 <sup>a</sup>	0	1,615	4,838	0
Total Construction Requirements	3,774	-	0	2,510	5,140	0
Long-Term Base Operations <sup>1</sup>	6,130	2,230	2,500	0	0	1,300
Long-Term DA Operations <sup>1</sup>	3,900	32 <sup>a</sup>	0	0	17	0
TOTAL:	10,030	-	2,500	0	17	1,300

Notes: 1 Increase in annual energy use attributable to Peacekeeper system operation.

a Individual Launch Facility.

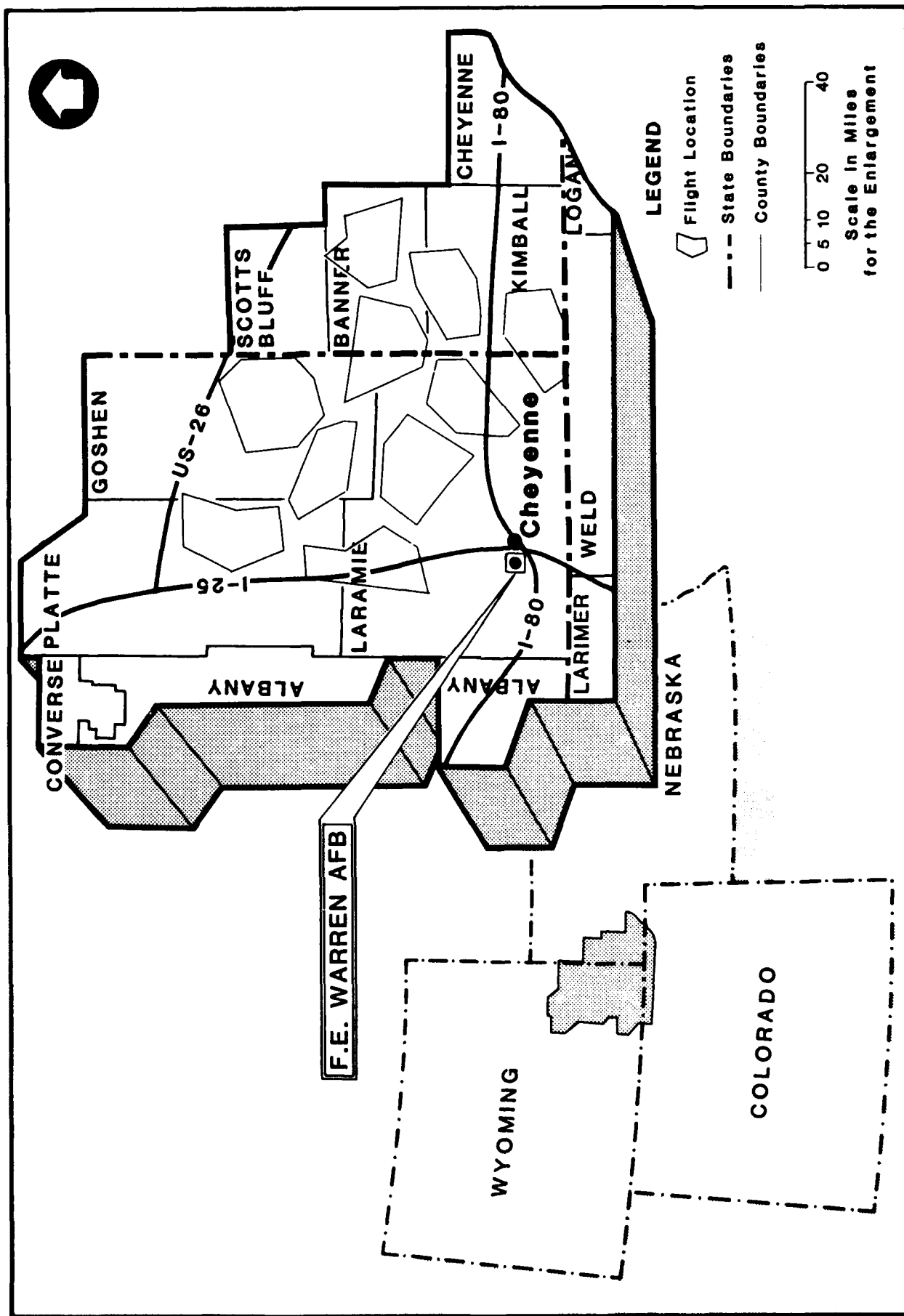
## 2.3 Region of Influence

### 2.3.1 Definition

The Region of Influence (ROI) for energy resources (Figure 2.3.1-1) is defined as the service areas of 3 rural electric companies and Cheyenne Light, Fuel and Power Company (Cheyenne LF&P) which together supply electricity to the 100 silos scheduled to receive missiles. The rural electric companies are the Wyrulec Electric Company, the Rural Electric Company, and the Wheatland Rural Electric Association (REA). In addition, the ROI includes the energy utility service areas of the cities and towns which will receive project-induced population as identified in the socioeconomic analysis. Specifically, these include Cheyenne, Chugwater, Pine Bluffs, Torrington, and Wheatland, Wyoming; Kimball, Gering, and Scottsbluff, Nebraska.

### 2.3.2 Justification

The ROI encompasses all areas that will have direct project energy impacts, in both Cheyenne and the DA. For towns outside the DA facing population impact, the ROI also includes the service areas of their respective electric and natural gas utilities. Local gasoline and diesel distributors are included within the defined ROI. The only identified coal user affected by the project is the heating plant on F.E. Warren AFB which is included.



REGION OF INFLUENCE FOR  
ENERGY RESOURCES

FIGURE NO. 2.3.1-1

None of the electrical and only one of the two natural gas utilities produces its own supply; nearly all utilities buy from regional wholesalers. While increased demand on the regional electrical grid or natural gas pipeline system may be anticipated to result from the project, the added demand is expected to be negligible at the regional level and thus neither the regional electric nor natural gas supplies are considered in detail.

The analysis in Section 3.1 narrows the ROI for each energy resource to an Area of Concentrated Study (ACS). The ACS is defined as that portion of the ROI which may experience potentially important energy impacts as a result of the proposed project. In most cases, the ACS for each energy resource was determined by comparing peak, project-related consumption to 1982 consumption. Those locations where minimal energy impacts are likely to occur due to the project were eliminated, and the bulk of the environmental analysis was concentrated on locations where potentially important impacts may occur. The ACS for the four energy resources are:

- o Electricity - The service area of the three rural electric companies mentioned above (which includes Chugwater), Cheyenne LF&P, and the electric departments of Kimball, Pine Bluffs, and Wheatland.
- o Natural Gas - The cities of Cheyenne, Kimball, Pine Bluffs, Torrington, and Wheatland.
- o Petroleum Products - The counties of Platte, Goshen, and Laramie, Wyoming; and Banner, Kimball, and Scotts Bluff, Nebraska.
- o Coal - F.E. Warren AFB.

The rationale for selection of these ACSs can be found in Section 3.1.

## 2.4 Derivation of Data Base

### 2.4.1 Literature Sources

State and federal energy documents were important sources of information for this report. The Energy Information Administration of the Federal Energy Department publishes annual and quarterly statistical summaries on the production and use of major energy sources including coal, natural gas, electricity, and fuels. The annual reports of the regional natural gas and electricity wholesalers contained useful supply and cost figures. The state energy departments publish reports which describe energy conservation measures being implemented in Wyoming and Nebraska. Maps published by the state geological surveys were useful in determining pipeline routes. The library of the Wyoming Department of Economic Planning and Development provided a wealth of information on energy activities in the state, including environmental impact statements on several proposed energy projects in the general region.

### 2.4.2 Groups and Agency Contacts

The bulk of the information on regional and local energy distribution and consumption came from interviews with energy purveyors. The two major suppliers of natural gas, Colorado Interstate Gas (CIG), and Kansas/Nebraska Natural Gas Company, Inc. (K/N), were interviewed regarding source and

dependability of supply. Similarly, the major wholesalers of electricity to the area were contacted for information on electrical generating capacity and planned expansions to meet future needs. Contacts in this group included the Western Area Power Administration (WAPA), Pacific Power and Light (PP&L), Tri-State Generation and Transmission Association, and the Nebraska Public Power District (NPPD).

Most of the information on local energy distribution systems was obtained from interviews conducted with the local energy purveyors. Municipal electrical departments and commercial or semipublic electric companies were the source of data on cost, consumption, peak demand, number of customers, expansion plans, and the pertinent data for the towns and cities in the ROI. The rural electric companies were sources of similar data in the rural areas. The local gas purveyors in the towns in the ROI were interviewed for similar kinds of data regarding natural gas. Both electric and gas companies supplied useful per capita consumption figures in many instances.

Two of the larger fuel distributors in the Cheyenne area were interviewed: Fleischli Oil Company and Carroll Oil Company. They provided general information on fuel distribution and use in the area, particularly concerning the competitive aspects of supplying major new demands. The manager of the major refinery in the area, the Husky Refinery, was also interviewed. A local coal distributor, Gem Coal Company, was contacted regarding major coal uses in southeast Wyoming.

Officials in the Nebraska and Wyoming Energy departments provided useful information on energy production and current conservation programs. The records of the Public Service Commissions of Wyoming and Nebraska provided useful natural gas and electrical supply information at the local level. Local energy concerns from the Cheyenne-Laramie County Regional Planning Office were also received.

Members of the engineering staff at F.E. Warren AFB were interviewed to determine electrical, natural gas, and coal use at the base and in the missile DA. Base fuel use data were obtained from the Fuels Allocation Officer.

#### 2.4.3 Primary Data

No primary data (fieldwork) were collected for this report.

#### 2.5 Analytic Methods for Existing Conditions

Information for the general assessments of the existing, statewide energy situation for the four energy resources was obtained from existing literature.

##### 2.5.1 Electricity

Interviews with local utility managers were the primary means of deriving data on the existing electrical supply systems. Qualitative assessments by the electrical utility managers were used to determine the adequacy and reliability of the existing level of service. No independent assessment of system capacity was attempted. The monthly costs to residential consumers in Tables 2.6.2-1 and 2.6.2-2 were derived by dividing the average annual residential consumption by 12 and then applying the current monthly domestic rate structure.

Data on regional electrical wholesalers were derived primarily from their annual reports. This included information on total generating capacity and kilowatt hours (kWh) sold. Where additional information was needed, direct contact with an operations manager was initiated.

#### 2.5.2 Natural Gas

Data regarding the local natural gas distribution systems were gathered in a manner similar to that described for electricity in Section 2.5.1. The managers of the local gas utilities were interviewed to obtain the data needed to characterize the existing systems. Local, average residential gas consumption figures were applied to existing rate structures to obtain the average monthly costs shown in Table 2.6.3-1. Service reliability was judged from information obtained regarding instances of gas interruption during the past 2 to 3 years. Information on the regional gas wholesalers was derived from both annual reports and interviews.

#### 2.5.3 Petroleum Products

Records from the Wyoming Department of Revenue and Taxation (1982) provided data on local tax revenue collected from gasoline sales. Such tax information is reported at the town level. A conversion factor of 108.7 gallons per tax dollar was used to convert the gasoline sales tax data to gallons of gasoline. No local or county-level tax records are kept for gasoline sales in Nebraska. Only statewide gallonage figures (Nebraska Department of Revenue 1982) are available. A per capita consumption value was derived using 1980 Census data. This value was then multiplied by the 1982 Nebraska town populations in order to obtain the gasoline consumption estimates shown in Table 2.6.4-3.

Only statewide diesel fuel consumption figures were available for either Nebraska or Wyoming. Nebraska keeps no records which specifically account for diesel use in the state. However, a tax category called "special fuels" does exist. It includes diesel and liquid petroleum fuels such as propane and butane. The great majority of the "special fuel" use is diesel (Nebraska Department of Revenue 1983). For this analysis it is assumed that 100 percent of the "special fuel" use is diesel fuel. As with gasoline, per capita consumption estimates were derived and then applied to the local population figures to obtain an estimate of current diesel consumption.

#### 2.5.4 Coal

Data on coal use in the ROI were gathered primarily from state-level compilations published by the U.S. Department of Energy (DOE) (1983a, 1982b). No further methodology was used in presenting current coal consumption information for the ROI.

### 2.6 Existing Environmental Conditions

#### 2.6.1 National General Energy Situation

Despite falling world petroleum prices, the economic recession contributed to the unusually large 4.1-percent decline in total U.S. energy consumption between 1981 and 1982. This was the third consecutive annual decline in total

U.S. energy consumption since energy use reached its all-time high in 1979. Most of this decline involved petroleum and natural gas. Reduced petroleum demand translated into a 21.7-percent reduction in net petroleum imports, and crude oil prices fell for the first time in more than a decade. Natural gas demand and production fell, prompted by reduced economic activity and a substantial increase in prices. Weakened market conditions adversely affected the rate of domestic oil and gas exploration and development activities; nonetheless, domestic crude oil production rose 1.2 percent.

#### 2.6.1.1 Energy Consumption - Wyoming

Due to Wyoming's relatively large mineral industry which is highly energy intensive, a relatively cold climate, low population base, and long distances between communities, the state in 1980 ranked first among all states in energy consumption per capita. In 1980, Wyoming consumed 842 million British thermal units (Btu) per capita, compared to the average U.S. energy consumption per capita rate of 334 million Btu. Between 1960 and 1980, Wyoming had the second largest per capita increase in energy consumption (101%) in the U.S. Moreover, Wyoming experienced a 185-percent increase in total energy consumption between 1960 and 1980. Again, the industrial sector accounted for the largest percentage of total energy consumption in 1980. Overall, Wyoming consumed 396 trillion Btu in 1980, a relatively small amount compared to other parts of the country.

#### 2.6.1.2 Energy Consumption - Nebraska

Nebraska's per capita energy consumption in 1980 compared closely to the overall U.S. per capita consumption rate (345 million Btu versus 334 million Btu, respectively). Between 1960 and 1980, the per capita energy consumption rate increased 54 percent. Overall, Nebraska consumed 542 trillion Btu in 1980 and experienced a 71-percent increase in total energy consumption between 1960 and 1980. The transportation sector accounted for the largest percentage of total energy consumption (U.S. Department of Energy 1982d).

Preliminary estimates of overall energy consumption in Nebraska in 1982 indicate the use of 533 trillion Btu, a decrease of 2 percent compared to the 1980 level (Nebraska Energy Office 1982).

### 2.6.2 Electricity

#### 2.6.2.1 Statewide Situation

##### 2.6.2.1.1 Wyoming

According to DOE statistical data, Wyoming utilities generated a net total of approximately 26 million megawatt hours (MWh) of electricity in 1981. This compares to the generation of approximately 16 million MWh in 1976, or a 62-percent increase. Coal-fired generation accounted for the largest percentage of electrical generation by Wyoming utilities with hydroelectric power providing the bulk of the remaining percentage (U.S. Department of Energy 1982c).

Wyoming utilities sold approximately 7.7 million MWh of electric energy to all ultimate customers in 1981. This represents a 7.5-percent increase over the

prior year and a 57-percent increase over the 1976 level. Wyoming utilities exported approximately 16 million MWh more in 1980 than came into the state, including associated losses.

The average monthly electric bill for residential customers who consume 750 kWh totaled \$25.69 in 1981. This compares with the overall 1981 U.S. average bill of \$43.99 for the equivalent consumption level.

#### 2.6.2.1.2 Nebraska

Nebraska Energy Office (NEO) statistical data (Nebraska Energy Office 1982) indicated that generation of electricity in Nebraska totaled approximately 17 million MWh in 1982. This compares to the generation of approximately 16 million MWh in 1981 (a 6% increase) and the generation of 13 million MWh in 1976 (a 31% increase in electricity generation).

In 1982, approximately half the state's electricity production was attributable to nuclear plants. The use of coal to generate electricity decreased slightly in 1982, compared with the 2 previous years. Percentages for the sources of electricity production in 1982 were as follows: nuclear, 50 percent; coal, 43 percent; hydroelectric, 6 percent; and petroleum and natural gas, less than 1 percent each.

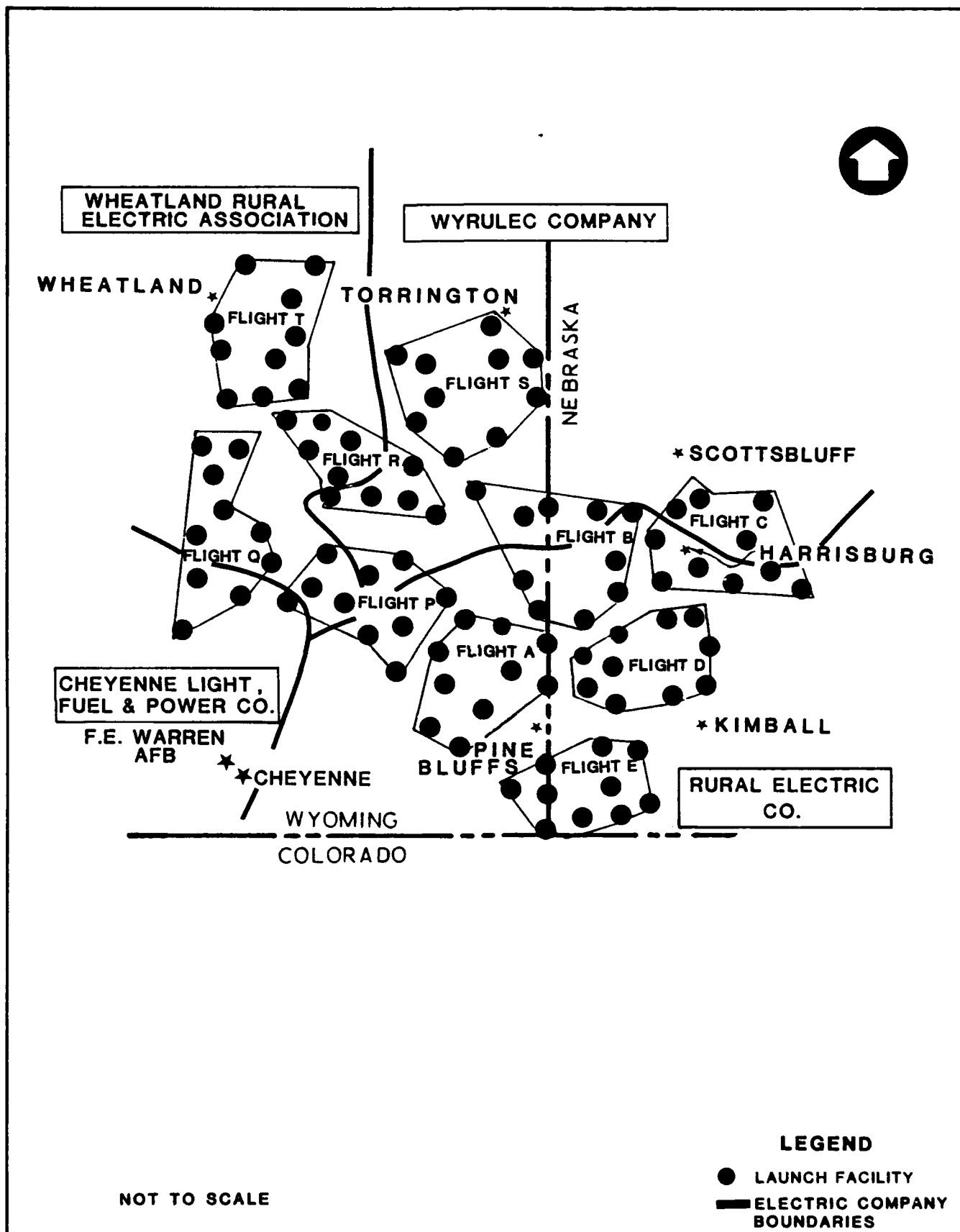
Nebraska utilities sold approximately 13 million MWh of electric energy to all ultimate customers in 1981 (1982 sales data were not available). This represents a 3-percent decrease from 1980; however, electric energy sales increased approximately 10 percent from 1976 to 1981. Nebraska utilities exported 150,000 MWh more out of the state in 1980 than came into the state, including losses.

The average monthly electric bill for a residential customer who uses 750 kWh totaled \$33.59 in 1981. This compares with the overall 1981 U.S. average bill of \$43.99 for the equivalent consumption level.

#### 2.6.2.2 Local Distributors

Electricity in the ROI is distributed either by town electrical utilities or by REAs. For the most part, a town electric utility serves only the town and its surrounding area. REAs serve the intervening, lightly populated rural areas and often the smaller towns. These associations were formed in the 1930s and early 1940s with the assistance of the Federal Rural Electrification Administration. They own little, if any, generating capacity of their own. Their electric supply comes from regional wholesalers. As shown in Figure 2.6.2-1, three rural electric associations supply electrical power to 96 of the 100 silos to be converted to project missiles. Average annual electrical consumption at each silo is about 180,000 kWh, while peak demand is approximately 25 kW. In 1982, these 3 rural electric companies supplied over 31 million kWh of electricity to the 220 Launch Facilities and Launch Control Facilities in the missile DA. Pertinent information on the rural electric associations is shown in Table 2.6.2-1.

Table 2.6.2-2 lists basic data on town electric utilities within and near the ROI. Electrical service to Chugwater is provided by the Wheatland REA. The remaining towns, with the exception of Cheyenne and Scottsbluff, have their



LAUNCH FACILITIES SERVED BY  
THE LOCAL ELECTRIC COMPANIES

FIGURE NO.  
2.6.2-1

Table 2.6.2-1

## RURAL ELECTRIC ASSOCIATIONS - 1982

Name	Location	Number of Customers	Peak Demand MW	Annual Consumption kWh x 10 <sup>6</sup>	Mean Annual Use per Residential Customer kWh	Mean Monthly Residential Cost	Wholesale Supplier	Electricity Supplied to the Air Force kWh x 10 <sup>6</sup>
Wheatland Rural Electric Association <sup>2</sup>	Wheatland, Wyoming	3,100	20	86	12,350	62	Tri-State <sup>1</sup>	6.1
Wyrulec Company	Lingle, Wyoming	3,650	28	87	10,250	51	WAPA <sup>3</sup> Tri-State	5.8
Rural Electric Company	Pine Bluffs, Wyoming	6,000	43	153	11,760	58	Tri-State	19.5

Notes: <sup>1</sup>Tri-State Generation and Transmission Association, Inc.

<sup>2</sup>Includes service to the town of Chugwater, Wyoming.

<sup>3</sup>WAPA: Western Area Power Administration

Source: Interviews with the staffs of the REAs.

Table 2.6.2-2

## CHARACTERISTICS OF CITY AND TOWN ELECTRIC UTILITIES - 1982

Distributor	Number of Customers	Peak Demand MW	Annual Consumption kWh (x10 <sup>6</sup> )	Mean Residential Consumption kWh/Year	Average Residential Monthly Cost \$	Wholesale Supplier
Cheyenne Light, Fuel and Power Company	28,000	83	462	6,250	23.83	Pacific Power and Light Company, Western Area Power Administration
Wheatland Electric Department	2,141	5.3	27	6,000	30.40	Western Area Power Administration, Laramie River Station
Torrington Electric Department	3,052	9.2	46	5,125	16.38	Western Area Power Administration, Pacific Power and Light Company
Pine Bluffs	696	1.6	7	6,000 <sup>c</sup>	34.00	Western Area Power Administration; Laramie River Station
Chugwater <sup>1</sup>	500-600	1.5	8	6,000 <sup>c</sup>	37.07	Wheatland Rural Electric Association
Kimball Electric Department	1,700	4.1	20	6,040	35.43	Nebraska Municipal Power Pool
Gering Electric Department	3,349	17.7	54 <sup>b</sup>	6,000 <sup>c</sup>	25.41	Western Area Power Administration, Nebraska Municipal Power.
Nebraska Public Power District (Scottsbluff - Terrytown)	6,334 <sup>a</sup>	27	148	6,000	41.00	Nebraska Public Power District

Notes: 1 The Wheatland Rural Electric Association serves the Chugwater area. The values shown here are for its Chugwater Substation.

a Residential customers only.

b 1981 data

c Assumed; no specific data available.

Source: Unpublished data provided by the Distributors.

own municipal electric departments. Like the REAs, the town utilities generally have no generating capacity of their own but rather import all of their electricity from large regional suppliers. One exception to this is Kimball, Nebraska, which owns a 9,300 KW gas/diesel-fueled generating plant. Cheyenne LF&P also has six diesel units which can be used during periods of peak-power demand. However, there has been no need to use these units during the last year. Four of the silos proposed for Peacekeeper conversion are served by Cheyenne LF&P.

None of the rural or town electric utilities reported any major difficulties in meeting present customer electrical demand. Nearly all reported significant excess capacity in their local substations and distribution systems. The Kimball and Wheatland systems have in the past supported populations at least 25 percent higher than at present (City of Kimball 1983 and City of Wheatland 1983).

### 2.6.2.3 Regional Electrical Wholesalers

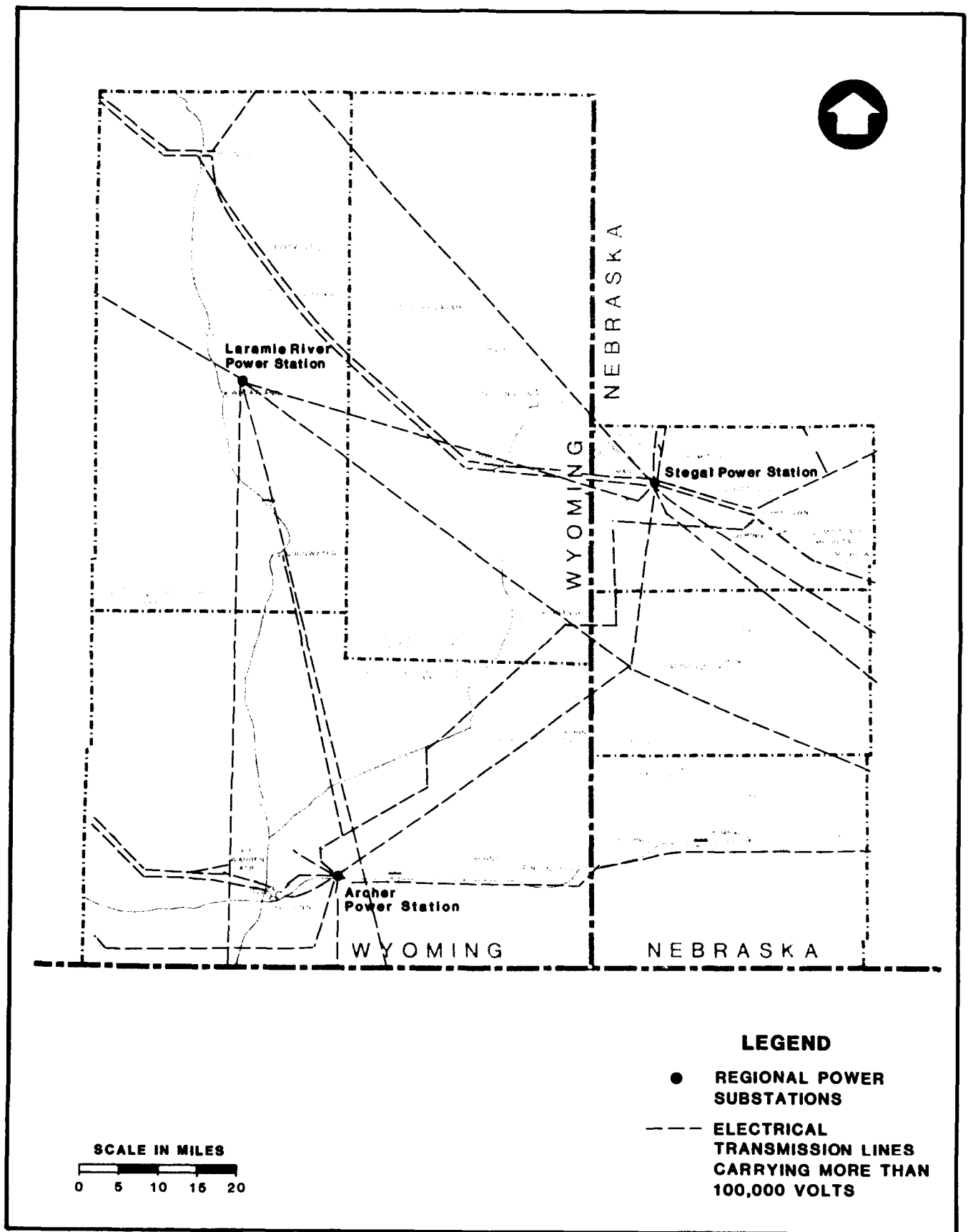
As mentioned previously, few of the local electric companies own any generating facilities, and those that do rarely use them due to the availability of cheaper, regional power. The regional wholesalers own most of the high voltage transmission lines in the area (Figure 2.6.2-2). A brief description of the five major electrical suppliers serving the ROI is given below.

WAPA, with headquarters in Denver, is the marketing agency for federal government power facilities operated mainly by the Bureau of Reclamation and the Corps of Engineers. At present, the total installed capacity of these federal power producers is 8,255 MW from 47 hydroelectric plants and 1 fossil fuel plant (550 MW). In fiscal year (FY) 1981, WAPA sold 34,839,585 MWh of energy (WAPA 1981). Undeveloped potential hydropower capacity is reported as 4,140 MW, plus 5,340 MW of pumped storage and potential imports of 1,000 MW from Canada. Future generating options also include wind turbines, geothermal, and solar electric energy. However, there are no plans for the construction and development of any of these energy sources at this time.

Historically, WAPA-supplied electricity has been cheaper to the customer than any alternative. In 1981, the average price was only 0.94 cents per kWh. At prevailing price levels, demand far exceeds WAPA supply, and available power is allocated to customers on a priority basis. Current supply contracts will be in effect until 1989.

F.E. Warren AFB has a current contract for direct purchase of electricity from WAPA. In FY 1982 almost 24 million kWh were purchased at a unit cost of 0.658 cents per kWh. This served about 89 percent of total base needs.

With headquarters in Thornton, Colorado, Tri-State Generation and Transmission Association (Tri-State) is owned by and supplies power to 25 rural electric cooperatives in Wyoming, northeastern Colorado, and western Nebraska. Power sources include multicompany projects such as the recently completed 1,500 MW Laramie River coal-fired plant, part of the Missouri Basin Power Project. Tri-State's total available generating capacity includes 598 MW of coal-fired generation and 345 MW of combustion turbines. Tri-State reports having a generation capacity surplus to meet their predicted needs through 1990 (Tri-State 1983). In 1981, Tri-State produced 2,469,000 MWh and purchased



**ELECTRICAL TRANSMISSION  
LINES**

**FIGURE NO. 2.6.2-2**

3,280,000 MWh, of which 2,300,000 MWh were supplied by WAPA. The average wholesale cost of power supplied to its owner REAs in 1981 was 3.3 cents per kWh (Tri-State 1981).

PP&L, an investor-owned company with headquarters in Portland, Oregon, sold over 24 million MWh in 1981, including 5.5 million MWh to other utilities such as Cheyenne LF&P at an average price of 3 cents per kWh. The company operates in six northwest and Rocky Mountain states. Energy sources were 60 percent steam electric (5 plants), 13 percent hydroelectric (33 stations), and 27 percent purchased under contract. Most of the steam energy is coal-fired. The company has an ownership share in several new plants, both coal and nuclear power. Expansion plans include renewable energy in the form of geothermal, wind, photovoltaic, and small hydropower purchases, in addition to an active consumer conservation program. These renewable energy sources together can account for up to 4 percent of the company's total energy resources by 1995 (PP&L 1981).

The Nebraska Municipal Power Pool (NMPP) was formed as a nonprofit corporation in 1975. NMPP serves all or a portion of the power needs of 34 municipalities. In 1981, all NMPP power contracts were assigned to the Municipal Energy Agency of Nebraska (MEAN). MEAN is a political subdivision of the State of Nebraska which provides power supply, energy transmission, and exchange of electrical power to its member municipalities. MEAN contracts with five large regional generating systems for the purchase of wholesale power for distribution to its members. There has been a 124-percent increase in power sales between 1980 and 1982 and further rapid growth is expected. Nearly 400,000 MWh were sold in 1982 at an average of 2.7 cents per kWh (NMPP 1982).

The NPPD is also a political subdivision of the State of Nebraska. Its generating facilities include 6 coal-fired plants, 1 nuclear plant, 11 hydropower plants, and 3 peaking turbines for a total of 2,773 MW of capacity. Coal plants account for 60 percent of the capacity while the Cooper Nuclear Power Station accounts for 27 percent. NPPD also owns 6,308 miles of transmission lines. The corporation retails power directly to over 107,000 customers. It also serves all or portions of the needs of 71 municipalities and 26 other power districts and cooperatives. In 1982, a total of 9.1 million MWh was sold. A peak demand of 1,177 MW occurred in January 1982. Both peak demand and annual sales are projected to grow by 4 percent annually (NPPD 1982).

Although WAPA's electrical output is fully committed, the remaining wholesalers have ample capacity to serve the ROI through the 1980s. The region is generally in a favorable position from an electrical energy supply standpoint. In 1981, the final unit of the Laramie River Station was completed. Located near Wheatland, Wyoming, this coal-fired plant has a net generating capacity of 1,500 MW, and was formerly known as the Upper Missouri Basin Power Project (U.S. Rural Electrification Administration 1976). Greyrocks Dam and Reservoir were constructed on the Laramie River to supply cooling water. Tri-State is a major partner in the project. The Laramie River Station makes the ROI a net electrical energy exporter for the first time.

### 2.6.3 Natural Gas

#### 2.6.3.1 Statewide Situation

##### 2.6.3.1.1 Wyoming

Total consumption of natural gas in Wyoming in 1981 was approximately 69 billion cubic feet (BCF), approximately equal to Wyoming's consumption of natural gas in 1980 and well below the 1979 level of 94 BCF. The industrial sector accounted for approximately 70 percent of total natural gas consumption in 1981 (U.S. Department of Energy 1982a). As with electricity, Wyoming is a net exporter of natural gas. Natural gas production in Wyoming accounted for 2 percent of total U.S. domestic production in 1981. According to DOE statistics, approximately 455 BCF of natural gas was withdrawn from wells in Wyoming in 1981. Residential consumers in Wyoming paid an average of \$3.51 per thousand cubic feet (MCF) of natural gas in 1981. This compared to the U.S. average equivalent of \$4.29 in 1981.

##### 2.6.3.1.2 Nebraska

In 1981, approximately 138 BCF of natural gas was consumed in Nebraska. This represented a 15-percent decline in consumption as compared to the 1980 level. The residential, commercial, and industrial sectors all consumed approximately the same amount of natural gas, totaling 90 percent of overall consumption (U.S. Department of Energy 1982a).

Production of natural gas in Nebraska accounted for only 0.01 percent of the total U.S. domestic production in 1981. Approximately 2.7 BCF of natural gas was withdrawn from wells in Nebraska in 1981, with the majority (77%) coming from oil wells. Approximately 93 percent of the total withdrawn was marketed for production.

Residential consumers of natural gas in Nebraska paid an average of \$3.45 per MCF in 1981. Once again this is substantially below the overall U.S. average equivalent of \$4.29 in 1981.

#### 2.6.3.2 Local Distributors

Natural gas distribution to the ROI is considerably different from that of electricity. In general, natural gas transmission lines serve only the cities or sizable towns where 80 to 95 percent of the dwellings use natural gas for heating. But the rural areas are not served, and the isolated farmhouses and the smaller towns must use heating oil, propane, or electricity for heating. Figure 2.6.3-1 shows the natural gas transmission lines which run through the ROI.

Table 2.6.3-1 summarizes the natural gas supply statistics for towns and cities in or near the ROI. Cheyenne's apparently high total gas consumption was due to the demands of a large industrial customer, Wycon. Wycon used natural gas to produce nitrogen fertilizer and consumed approximately 40 percent of the natural gas sold by Cheyenne LF&P in 1982 (Cheyenne LF&P 1983). Residential gas consumption is closely tied to the winter weather that occurs. As Table 2.6.3-2 illustrates, average residential gas use in Cheyenne has varied by 33 percent over the last 5 years and is closely tied to the

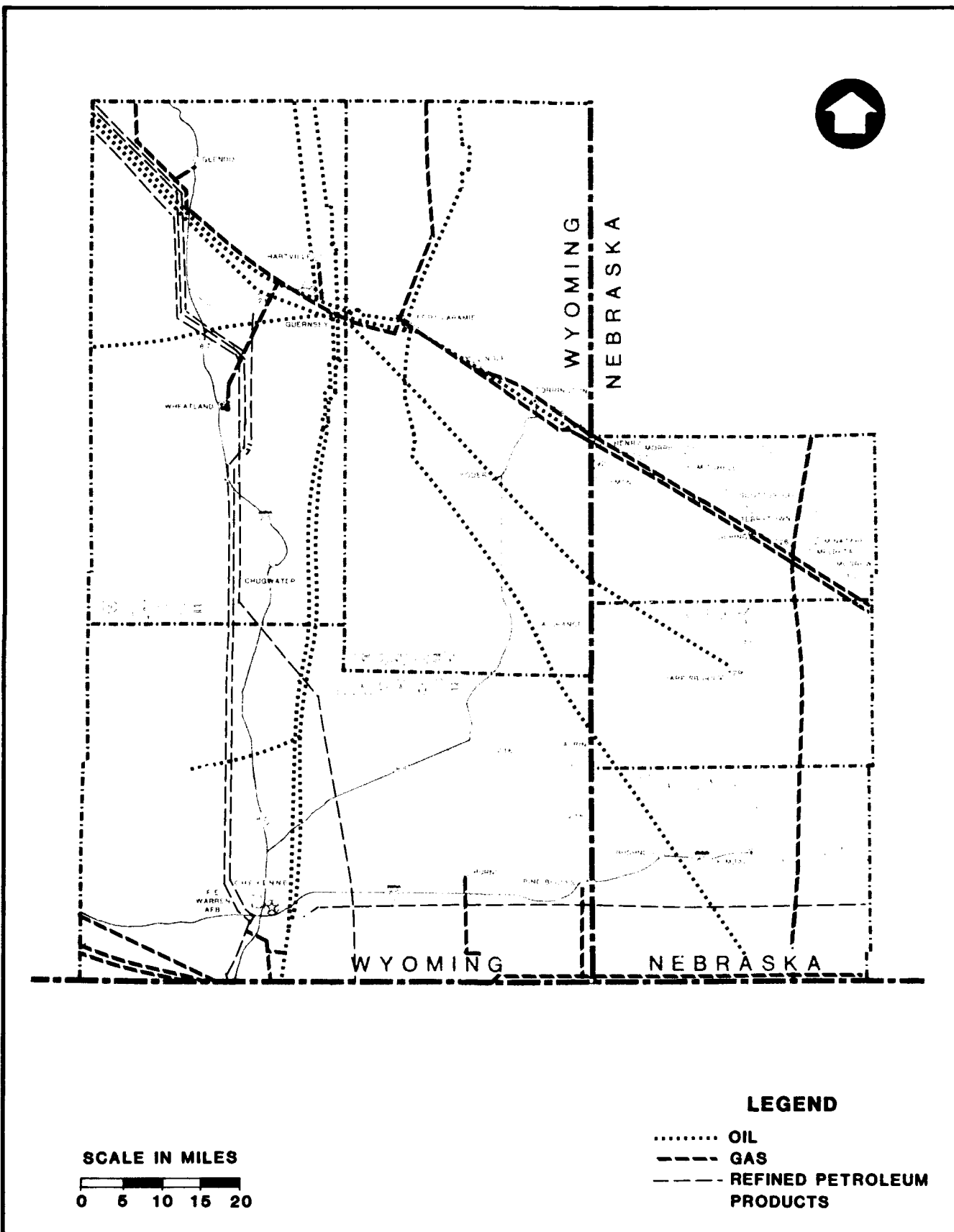


Table 2.6.3-1

## NATURAL GAS CONSUMPTION - 1982

<u>Town</u>	<u>Distributor</u>	<u>Number of Customers</u>	<u>1982 Gas Sold MMCF</u>	<u>Mean Annual Residential Gas Use MCF</u>	<u>Average Monthly Residential Cost \$</u>	<u>Wholesale Supplier</u>
<u>Nebraska</u>						
Kimball	K/N <sup>1</sup>	1,425	280	128	37.82	K/N
Gering	K/N	3,000	478	122	39.02	K/N
Scottsbluff	K/N	6,050	1,179	125	39.94	K/N
<u>Wyoming</u>						
Torrington	K/N	2,260	389	117	37.50	K/N
Wheatland	K/N	1,825	314	124	39.62	K/N
Cheyenne	Cheyenne LF&P	23,636	14,200	141	49.76	CIG <sup>2</sup>
Pine Bluffs	Cheyenne LF&P	-----	Included under Cheyenne		-----	CIG

Notes: 1 K/N - Kansas/Nebraska Energy Company, Inc.

2 CIG - Colorado Interstate Gas

Sources: Unpublished data from Kansas/Nebraska Natural Gas Company Inc.; Cheyenne Light, Fuel and Light Power Company; Public Service Company of Colorado; and Greeley Gas Company.

relative harshness (heating degree-days) of the winter weather. The average residential gas use values shown in Table 2.6.3-1 reflect 1982 consumption and were derived from the gas utilities.

Chugwater has no natural gas system. The homes there are heated by wood, electricity, coal, or propane. Until recently the propane was delivered to individual customers by truck from Wheatland. Recently, a local propane distributor has begun operation in Chugwater. No shortages in fuels for heating have occurred in recent years (Chugwater City Councilman 1983).

Although a coal-fired hot water plant heats most of the existing buildings at F.E. Warren AFB, buildings at the southern end of the base and three tracts of housing on the base are heated by natural gas. The gas is supplied by Cheyenne LF&P. Consumption on the base was 332,872 MCF in 1982. None of the natural gas distributors contacted indicated any supply or distribution problems during the past 11 years. No interruption of service to customers has occurred during this period.

### 2.6.3.3 Regional Natural Gas Wholesalers

K/N obtains its gas supply for its customers along the North Platte Valley from gasfields located in the Powder River Basin in central Wyoming. Similarly, gas developments in the Wyoming Overthrust Belt now allow CIG to supply most of the demands of its customers in the ROI with Wyoming-produced gas. In 1982, total CIG natural gas production was 323.2 BCF. K/N production was 93.5 BCF. Both companies report ample supplies to serve foreseeable demand (CIG 1983 and K/N 1983).

Table 2.6.3-2

#### HISTORICAL RESIDENTIAL NATURAL GAS CONSUMPTION IN CHEYENNE

	<u>Degree-Days</u> <sup>1,2</sup>	<u>Mean Gas Use</u> (MCF) per <u>Residence</u>
1978	7,678	151
1979	7,179	152
1980	6,887	133
1981	6,336	114
1982	7,534	129

Notes: 1 Degree-Day, Heating: a unit, based upon temperature difference and time, used in estimating fuel consumption and specifying the nominal heating load of a building in winter. For any 1 day, when the mean temperature is less than 65° F, there are as many degree-days as degrees Fahrenheit difference in temperature between the mean temperature for the day and 65° F.

2 Average Degree-Days: 7,255

Source: Cheyenne Light, Fuel and Power Company, unpublished data.

## 2.6.4 Petroleum Products

### 2.6.4.1 Statewide Petroleum Situation

#### 2.6.4.1.1 Wyoming

More than 130 million barrels (MMB) of crude oil were produced in Wyoming in 1981, compared with approximately 126 MMB in 1980. Producing wells totaled 11,574 in 1981, a 9-percent decline from 1980, and approximately 2 percent of total U.S. producing wells. Crude oil production in Wyoming in 1981 represented approximately 4 percent of total U.S. domestic production.

Consumption of motor gasoline in Wyoming in 1981 totaled approximately 375,068,000 gallons, an increase of 5 percent over the 1980 level, and less than 1 percent of total U.S. motor gasoline consumption. Consumption of distillate fuel oil in Wyoming totaled 523,026,000 gallons, a decrease of approximately 6 percent compared to the 1980 level, and just over 1 percent of total U.S. consumption. As can be expected, the transportation sector accounted for 95 percent of motor gasoline consumption; the transportation sector and industrial sector (which includes agricultural operations) together accounted for 95 percent of distillate fuel consumption, with both sectors accounting for half of that amount.

#### 2.6.4.1.2 Nebraska

Crude oil production in Nebraska was up during the first 3 quarters of 1982, compared with the same 9 months of 1981. More than 5.1 MMB of oil were produced between January and September of 1982. Production in Nebraska in 1981 represented approximately 0.2 percent of total U.S. domestic production. Producing wells totaled 1,870 in 1981, approximately 0.3 percent of total U.S. producing wells.

Consumption of motor gasoline in Nebraska in 1982 totaled approximately 788,484,000 gallons, less than 1 percent of total U.S. motor gasoline consumption. Consumption of distillate fuel oil totaled 376,370,400 gallons in 1982, just below 1 percent of total U.S. consumption. Declines in motor gasoline and distillate fuel consumption were evident for the fourth straight year. According to NEO personnel, such declines are attributable to a growing trend away from gasoline to gasohol, reduced economic activity, a greater awareness of energy efficiency, and favorable weather conditions (Nebraska Energy Office, personal communication with staff 1983). In addition, increasingly stringent federal regulations regarding fuel efficiency for new cars has contributed to a decline in fuel use in recent years.

Similar to Wyoming, the transportation sector accounted for over 91 percent of motor gasoline consumption and 55 percent of distillate fuel consumption. The industrial sector accounted for 37 percent of distillate fuel consumption.

#### 2.6.4.2 Local Consumption of Gasoline

Gasoline consumption figures for Wyoming towns are derived from state sales tax data for gasoline (Wyoming Department of Revenue and Taxation 1979 to 1982). Table 2.6.4-1 shows that gasoline consumption peaked from 1978 to

1979. Consumption fell after this time, probably in response to rising gasoline prices and, more recently, the national economic recession. Cheyenne and Laramie are actually experiencing a lesser rate of consumption than in the mid-1970s. The recent drop in gasoline consumption in Wheatland can be traced to the loss of local employment following the construction of the nearby Laramie River Power Station.

Table 2.6.4-1

FUEL CONSUMPTION IN SELECTED WYOMING TOWNS  
(Millions of Gallons)

<u>Town</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>% Change 1976-1982</u>	<u>Estimated Diesel Consumption 1982</u>
<sup>1</sup> Cheyenne	39.5	40.7	44.8	40.5	40.4	38.4	38.6	-2	12.0
Pine Bluffs	1.5	1.6	1.5	2.7	1.7	1.6	1.8	20	0.2
Torrington	4.3	4.6	4.9	4.7	3.9	3.8	4.7	9	1.1
Wheatland	4.5	4.9	5.6	7.1	6.7	6.2	4.9	9	1.2

Note: 1 Cheyenne Urban Area.

Source: Wyoming Department of Revenue and Taxation Annual Report, 1979, 1980, 1981, 1982.

Nebraska collects gasoline sales taxes from importing dealers directly. Thus, there is no local breakdown of gasoline consumption within the state. Table 2.6.4-2 shows that, statewide, there has been a decline of 23 percent in gasoline consumption between 1979 and 1983. This is attributable in part to rising gasoline prices, the national recession, and the active promotion of gasohol in the state. Statewide use of the latter reached 66 million gallons (MG) in 1982. The per capita consumption of gasoline was 425 gallons in 1982. Table 2.6.4-3 shows the estimated fuel consumption in selected Nebraska towns.

Local distributors supply the fuel needs of F.E. Warren AFB. The current supplier is the Fleischli Oil Company. Fuel allocation at the base is carefully managed. The 1982 gasoline consumption was 729,000 gallons. The goals for 1983 gasoline usage is for a 9-percent reduction below 1982. If met, fuel use would be the same as that achieved in 1980.

Table 2.6.4-2

FUEL CONSUMPTION IN NEBRASKA  
(Gallons)

	<u>Diesel<sup>1</sup></u>	<u>Gasoline</u>
1979	147,858,359	868,408,185
1980	144,459,038	783,040,872
1981	139,577,804	734,654,389
1982	146,483,803	670,865,039

Note: 1 Includes liquid petroleum fuels (see Section 2.5.3)

Source: Nebraska Department of Revenue Annual Report, 1979, 1980, 1981, 1982.

Table 2.6.4-3

ESTIMATED 1982 FUEL CONSUMPTION IN SELECTED NEBRASKA TOWNS  
(Millions of Gallons)

	<u>Gasoline<sup>1</sup></u>	<u>Diesel<sup>2</sup></u>
Kimball	1.34	0.28
Scottsbluff	6.09	1.24
Gering	2.42	0.51

Notes: 1 Per capita consumption of 425 gallons per year.  
2 Per capita consumption of 90 gallons per year.

#### 2.6.4.3 Local Consumption of Diesel Fuel

Nebraska diesel import figures in Table 2.6.4-2 show a decline between 1979 and 1981. In 1982, imports increased almost to the 1979 levels. Per capita consumption in the state is approximately 90 gallons per year; 1982 consumption estimates are shown in Table 2.6.4-3.

Wyoming keeps no data on diesel fuel consumption. Available national data indicate that statewide, 2.27 MMB (95 MG) of diesel fuel was used in 1981 (U.S. Department of Energy 1982d). This calculates to an average annual consumption of 200 gallons per person. Estimated local diesel use for selected Wyoming towns is shown in Table 2.6.4-1.

Use of diesel fuel at F.E. Warren AFB was 79,000 gallons in 1982. The goal for 1983 is for a 17-percent reduction in diesel use.

#### 2.6.4.4 Refineries and Regional Fuel Supply

The Cheyenne area has a single petroleum refinery, the Husky Refinery. It has a capacity of 30,000 barrels per day (bbl/day). In 1982, it produced nearly 5 MMB of gasoline products and over 2 MMB of diesel fuels (Husky Oil Refinery, personal communication with the Manager 1983). Most of its crude oil comes by pipe from the Rocky Mountain area. However, some oil is trucked in from wells near Greeley, Colorado.

Regional fuel supply to the Cheyenne area occurs via truck and rail shipments. The WYCO pipeline also delivers refined fuels to the Cheyenne area. Local delivery is handled by about a half dozen major suppliers. Data on quantities handled are generally unavailable due to competitive reasons.

#### 2.6.5 Coal

##### 2.6.5.1 Statewide Situation

###### 2.6.5.1.1 Wyoming

Wyoming coal resources are a significant part of the overall national supply. However, in 1982, Wyoming's production and distribution of coal accounted for only 2 to 3 percent of total U.S. domestic production and distribution. Approximately 108 million short tons of bituminous coal and lignite were produced and distributed in Wyoming in 1982. Almost all of this was strip-mined and shipped by rail or used by mine-mouth generation plants.

Total consumption of coal in Wyoming in 1980 was approximately 15 million short tons, virtually identical to the amount consumed in 1979. Consumption had generally risen steadily between 1960 and 1979. Use of coal for electrical generation accounted for approximately 88 percent of total consumption. The new Laramie River generating plant at Wheatland, Wyoming, consumes an additional 7 million short tons per year.

###### 2.6.5.1.2 Nebraska

There is no appreciable coal production in Nebraska. In 1981, consumption of coal in Nebraska totaled approximately 5.3 million short tons. Input of coal at electric utilities accounted for approximately 94 percent of total consumption. This sector also accounted for the large increase in consumption between 1979 and 1980, as consumption of coal in the residential, commercial, and industrial sectors declined.

##### 2.6.5.2 Region of Influence

Notable coal consumption in the ROI is limited to a few locations. By far the largest consumer is the Laramie River Power Station near Wheatland, Wyoming. It is capable of generating 1,500 MW and uses up to 7 million tons of coal per year, about half of Wyoming's total consumption. The new Rawhide Power Plant in northern Colorado will generate 250 MW when it comes on line in 1984. Approximately 0.9 million tons of coal will be burned annually.

#### 2.6.6 Energy Conservation

The Air Force and the states of Wyoming and Nebraska have energy conservation programs which seek to minimize the amount of consumption of energy resources, particularly those which are measurable (i.e., coal, petroleum, and natural gas). These programs are briefly discussed in this section. In addition, a number of residential building codes which require innovative energy conservation features are briefly reviewed in Appendix A.

##### 2.6.6.1 Air Force Program

In an effort to minimize the consumption of fossil fuels in Air Force operations, a variety of energy management programs and techniques have been adopted and are being implemented. A systematic approach to energy conservation throughout the planning, design, construction, and operational phases of new projects is now formal Air Force policy.

In January 1974, an Energy Management Division was established to act as the focal point for all air staff energy-related activities. To ensure that the Air Force has the capability to accomplish its basic mission (aircraft operations) at a reasonable cost, the Air Force Energy Management Division developed an aggressive program to conserve energy, increase energy efficiency, and assure energy supplies. The energy conservation, efficiency, and supply goals established by the Air Force affect the fuels used for aircraft and vehicle operations, as well as the building and process energy required in installation operations.

As a framework for meeting its energy goals, the Air Force established general strategies focusing on various equipment modifications, improved management procedures, and conversion to the use of alternative or renewable energy sources for each functional area. Each strategy comprises a variety of measures designed to conserve energy as well as to develop, or take advantage of, new energy-efficient technology.

The specific measures to be applied are established annually in detailed energy plans (U.S. Air Force 1980). These are incorporated in an overall Air Force energy program plan for submission in an annual Department of Defense energy program review.

Adopted energy conservation and efficiency goals for Air Force installations are to install least life-cycle cost energy conservation retrofits in all buildings with over 1,000 square feet (sq ft) of area by 1990. Additional goals (U.S. Air Force 1981) which apply specifically to building operations are to:

- o Reduce energy consumption in existing buildings 20 percent per gross sq ft of floor area by FY 1985, 25 percent by FY 1990, 30 percent by FY 1995, and 35 percent by FY 2000, as compared to the FY 1975 baseline level.
- o Reduce by 45 percent (as compared to the FY 1975 level) the average annual energy consumption in new buildings.

Energy conservation goals for installation operations (buildings operations and process activities) are to:

- o Reduce consumption of petroleum-based fuels 30 percent by FY 1985, 35 percent by FY 1990, 40 percent by FY 1995, and 45 percent by FY 2000, as compared to FY 1975 baseline levels.
- o Use coal or biomass (wood products) to provide 10 percent of the energy used in Air Force installations by FY 1985, 15 percent by FY 1990, 20 percent by FY 1995, and 35 percent by FY 2000.
- o Use renewable energy sources (solar, geothermal, and wind energy) to provide at least 1 percent of the energy used in Air Force installations by FY 1985, 5 percent by FY 1990, 10 percent by FY 1995, and 20 percent by FY 2000.

The Air Force has a variety of programs to reduce building energy use. One strategy involves an Energy Conservation Investment Program, where emphasis is placed on retrofitting buildings to make them more efficient through installation of energy monitoring and control systems and modifications for electrical central steam distribution and boiler plant systems.

Another strategy involves the use of alternative sources for facility energy. This strategy includes programs to establish a dual-fuel capability at large gas-fired heating plants, and to convert major fuel-burning installations to coal. The Air Force's philosophy is to monitor development of the various energy technologies and to be prepared to apply such knowledge when feasible. To meet its FY 1985 goal, the Air Force is focusing on the application of solar thermal systems (space heating, water heating), currently the most practical and economically feasible use of renewable energy sources.

As indicated, similar goals and strategies to reduce energy consumption in aircraft and vehicle operations have been adopted and are being implemented. Such measures generally relate to a reduction in the consumption of mobility fuels and an increase in fuel efficiency of equipment. In addition, other energy conservation programs are in force including an Energy Conservation Awareness Program to encourage Air Force personnel, through various educational and promotional activities, to conserve energy both on the job and at home. An Energy Conservation Contingency Plan requires each base to plan for possible energy shortages.

In FY 1981, as a result of its energy program, the Air Force realized considerable success in reducing energy usage, and has continued to make progress toward achieving its FY 1985 goals (U.S. Air Force 1982). Total energy consumption was reduced by 35 percent from FY 1973 to FY 1981 (from approximately 1,016 trillion Btu in FY 1973 to 655 trillion Btu in FY 1981).

In addition, specific energy conservation measures have been adopted by the Air Force, that are directly applicable to many of the new facilities to be developed as part of the proposed project. A recent series of "Engineering Technical Letters" issued by Air Force headquarters identify certain mandatory policies for energy conservation in all new facilities. The energy conservation topics dealt with in these technical letters include solar applications, use of computer energy analysis for building design, use of energy efficient

heating and cooling equipment, use of heat pumps, use of energy management systems to minimize energy use, and development of energy budgets for Air Force facilities. These technical letters are reviewed by Air Force engineers to determine their specific applicability to the Peacekeeper system.

The specific energy conservation measures to be implemented as part of the proposed project have yet to be identified. They will include detailed building and site engineering and architecture considerations, consistent with Air Force energy policies, as reflected in adopted plans, policies, and technical letters.

#### 2.6.6.2 Wyoming Energy Conservation Office

The Wyoming Energy Conservation Office (WECO) was established in July 1977 to administer programs funded under the Energy Policy and Conservation Act (EPCA) and the Energy Conservation and Production Act (ECPA). WECO has also been given the responsibility for programs supported under the National Energy Conservation Policy Act, the Energy Security Act, and the Emergency Energy Conservation Act. All of WECO's programs are funded and administered through the DOE.

In order to obtain funding under these programs, the State of Wyoming had to develop a plan which demonstrated the potential for achieving a 5-percent reduction in the projected 1980 energy consumption, and which included provisions for establishing lighting and thermal standards for buildings, promoting car pools, establishing conservation in government procurement practices, and enacting a law permitting a right turn on a red traffic light (Wyoming Planning Coordinator's Office 1977). In addition to these mandatory elements, the State plan included programs for promoting conservation in the industrial, commercial, agricultural, and educational sectors, as well as a public information and community grants program.

The general purpose of WECO is to promote the voluntary adoption of cost-effective energy conservation measures by all energy-consuming sectors. In order to accomplish this goal, WECO assumes two major responsibilities. The first responsibility is to encourage a voluntary reduction in the consumption of nonrenewable energy sources. It does this by providing reliable information on the need to conserve fossil fuels (i.e., oil and natural gas) and on techniques and technologies which can be employed for utilizing alternative energy sources such as solar and wind energy.

The second major responsibility is to promote the adoption of techniques and technologies that will reduce energy consumption by improving the operating and thermal efficiency of buildings. WECO has implemented programs to promote the installation of energy efficiency measures and/or alternative energy technologies through the provision of services and/or funds.

Specific programs implemented by WECO include:

- o Weatherization for low-income households;
- o Institutional conservation program;
- o Residential energy conservation audits;

- o State building energy audits and retrofit measures;
- o Establishment of community energy councils;
- o Public information program; and
- o Agricultural, industrial, and commercial energy efficiency education.

An Energy Extension Service (EES) was started in 1981. Under the direction of WECO, the EES is also conducting statewide education programs in the areas of residential and small business energy conservation, alternative energy sources, and pamphlet preparation.

#### 2.6.6.3 Nebraska Energy Office

Like the Wyoming program, the NEO was also established in 1977 to administer programs funded under the EPCA of 1975. The office has prepared annual conservation plans for the state of Nebraska in response to EPCA, the latest having been completed in May 1983 for FY 1983-84 (Nebraska Energy Office 1983). The plan proposes Nebraska-specific activities that are intended to produce significant energy savings and services.

The overall purpose of the NEO is to attain energy independence for the state of Nebraska. This purpose translates into energy conservation actions and the development of alternate sources of energy when possible and practical, with special attention to developments in the agricultural, commercial, and industrial sectors.

In order to accomplish its overall purpose, the NEO is engaged in the following activities:

- o Energy conservation for low-income citizens - weatherization programs;
- o Locally based energy planning, action-institutional conservation programs, and energy information efforts;
- o Energy education for Nebraskans - educational and public information programs;
- o Energy emergency preparation on a statewide basis - contingency plans;
- o Increased energy efficiency of state government buildings; and
- o Economic development - agricultural, commercial, and industrial sector conservation programs.

The NEO has developed programs which include information dissemination, outreach activities, community programs, and demonstration projects that are intended to significantly reduce energy consumption. The estimated energy savings that will occur through implementation of these actions is approximately 17 trillion Btu.

In addition to the programs funded under EPCA, the NEO will receive federal program funds from the DOE during 1983 for additional programs, including the EES, the Institutional Conservation Program, and the Weatherization Assistance Program. These and several other programs are similar in content and purpose to Wyoming's energy programs.

The NEO has taken a very active role in the development of alcohol fuels. The Nebraska Biomass Study, completed in 1982, determined that there are sufficient agricultural products in the state to support an alcohol fuel industry. Gasohol consumption in 1982 more than doubled from 24.8 MG in 1981 to 66 MG in 1982. In addition, the NEO continued its weatherization program for low-income households. By the end of 1982, 15,000 homes had been weatherized under the program (Nebraska Energy Office 1982).

Research and development projects in the field of alternate energy sources were under way at all levels of government and throughout the private sector. The NEO spearheads some of these alternate energy programs, and acts as an information clearing-house on various renewable and alternative energy projects, including biomass, geothermal, solar, and wind.

#### 2.6.6.4 Consistency of Air Force Energy Plans With State Conservation Programs

The overall intent, policies, and strategies for implementation of the Air Force Energy Plan are compatible with those of the Wyoming and Nebraska Energy Conservation offices. Emphasis on reducing energy use in Air Force facilities and vehicle operations and utilizing renewable and alternative energy sources where applicable, is consistent with the goals of the state offices. Specific Air Force measures implemented at F.E. Warren AFB to reduce energy consumption include:

- o Installation of energy conservation and thermal efficiency retrofits in renovated buildings;
- o Design of new buildings to meet the goal of a 45-percent reduction in energy consumption from the base year of 1975; and
- o The installation of more energy-efficient environmental control equipment (brine chillers) at the Minuteman Launch Facilities. This has reduced electrical consumption at the Launch Facilities by about 40 percent (F.E. Warren AFB Civil Engineering Office 1983).

**ENVIRONMENTAL CONSEQUENCES,  
MITIGATION MEASURES, AND  
UNAVOIDABLE IMPACTS**

### 3.0 ENVIRONMENTAL CONSEQUENCES, MITIGATION MEASURES, AND UNAVOIDABLE IMPACTS

This section presents a quantitative comparison of energy demands projected with and without the project. Project energy demands will be calculated in terms of resources needed to construct and operate the project (direct impacts), and induced energy demands exerted by people moving into the Region of Influence (ROI) because of the project (indirect impacts). Specifically, this section will examine the impacts of the proposed project on electrical power, natural gas, petroleum products, and coal. A number of the energy resources are nonrenewable: consumption depletes the finite recoverable reserves for that resource. Nonrenewable resources include natural gas, petroleum fuels, and coal. Depletion of nonrenewable resources is a national concern and is specifically examined in this section.

#### 3.1 Analytic Methods

This section details the criteria that were applied to narrow the focus of the detailed energy impact assessment to those localities with a potential for significant impact. The data and the numerical methods used in the individual impact analysis were also described.

The population projections developed in the Socioeconomics Environmental Planning Technical Report (EPTR) indicate that virtually all project growth will occur in towns and cities. The projection of the project-induced immigrants is substantially different from that given in the draft environmental impact statement (EIS) (see the Socioeconomic EPTR). The principal effect of the population reanalysis has been to reduce the number of immigrants expected to settle in Cheyenne, Wyoming, and to increase the number moving to the small towns in the Deployment Area (DA) during the peak construction years (Table 3.1.1-1). However, Cheyenne is still expected to receive the largest immigration. Therefore, the towns selected for detailed energy analyses have changed from those analyzed in the draft EIS. The basis for their selection is discussed below.

##### 3.1.1 Electricity

###### 3.1.1.1 Selection of the Area of Concentrated Study

The estimated increases in peak demand and annual electrical consumption were tabulated for all eight communities in the ROI (Section 2.3.1) by methods described in Sections 3.1.1.2 and 3.1.1.3. These induced electrical requirements were compared to the 1982 figures (Table 3.1.1-2). The baseline electrical requirements of all the communities are forecast to increase between 1982 and the year of peak project population. Therefore, comparison of the peak, project-related requirements with the 1982 electrical use in each community (Table 3.1.1-2) results in a conservative initial estimate of the project impact upon community electrical systems.

The towns of Torrington, Wyoming, and Gering and Scottsbluff, Nebraska, will experience induced effects on their electrical systems of 1 percent or less during the project and are not considered further. Cheyenne, Pine Bluffs, Chugwater, and Wheatland, Wyoming and Kimball, Nebraska, may be substantially affected and are therefore carried forward for more detailed analysis in

Table 3.1.1-1

## PROJECT-INDUCED POPULATION IN THE REGION OF INFLUENCE

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>
<u>WYOMING</u>								
Cheyenne	300	1,425	2,400	2,650	2,450	2,325	1,200	925
Pine Bluffs	--	--	25	0	150	0	0	--
Wheatland	--	--	225	475	200	0	0	--
Torrington	--	--	--	225	0	0	0	--
Chugwater	--	50	50	50	0	0	0	--
<u>NEBRASKA</u>								
Kimball	--	--	--	75	75	300	0	--
Gering	--	--	30	30	115	80	0	--
Scottsbluff	--	--	70	70	235	170	0	--

Table 3.1.1-2

## PRELIMINARY ANALYSIS - ELECTRICITY

	Consumption				Peak Demand			
	1982 kWhx10 <sup>6</sup> Consumption	Avg. Res. Consumption kWh	Peak Induced Pop.	kWhx10 <sup>6</sup> Induced	% of 1982	Existing Peak kW	Induced Peak kW	% of 1982
Cheyenne	462	6,250	2,625	5.05	1.1	83,200	1,325	1.6
Pine Bluffs	7.3	6,000 est	150	0.35	4.8	1,580	75	4.7
Torrington	46	5,125	225	0.45	1.0	9,188	113	1.2
Wheatland	27	6,000	475	1.15	4.3	5,334	238	4.5
Chugwater <sup>1</sup>	8.1	6,000 est	50	0.13	1.6	1,476	25	1.7
Kimball	18	6,040	300	0.68	3.8	4,100	150	3.7
Gering	54	6,000 est	115	0.27	0.5	16,000	58	0.4
Scottsbluff	148	6,000	235	0.54	0.4	32,100	118	0.4

Note: 1 A Wheatland REA electrical substation serves Chugwater.

Section 3.5.1. The impacts to the three rural electric companies, which supply electricity to the modified silos, will also be examined more closely as will the onbase construction and operational electrical needs.

#### 3.1.1.2 Baseline Future - No Action Alternative

Monthly energy (consumption) charges are governed by an existing contract with Pacific Power and Light Company (PP&L). Under this contract, Cheyenne Light, Fuel and Power Company (Cheyenne LF&P) is charged a specified rate for electricity supplied to customers up to a certain threshold level. Above this level a proportionately higher charge is applied. This higher charge is known as a ratchet charge. The impact of any increase in consumption is, therefore, evaluated in terms of its potential effect on the ratchet threshold.

The monthly energy charge for the first 36,500,000 kilowatt hours (kWh) is 1.5 cents per kWh, with the remainder 2.5 cents per kWh. In 1981 electrical consumption exceeded 36,500,000 kWh for all but 2 months and in no case dropped below 95 percent of this threshold value. It was assumed that in 1983 and beyond, all monthly consumption levels for Cheyenne LF&P customers would exceed the threshold (i.e., 36,500,000 kWh). The projected yearly consumption values in Table 3.5.1-1 were divided by 12 to derive monthly KWH estimates and multiplied by the energy charge discussed above.

Monthly demand charges to the utility were applied in a similar manner as the monthly consumption charges. The monthly demand charge is calculated on the basis of the highest demand the Cheyenne LF&P draws from the PP&L system in an entire year. Up to a certain threshold (73 megawatts [MW]), Cheyenne LF&P is charged monthly at \$4.00 per kilowatt (kW) of peak demand (the supply of electricity necessary to meet peak-demand periods). Above the level of 73 MW, the charge is increased to \$6.60 per kW of peak demand. Annual estimates of baseline peak-demand charges were added to annual baseline wholesale energy charges to reach an annual total wholesale baseline cost increase for electricity.

Baseline consumption and peak-demand forecasts for Cheyenne were taken directly from 10-year estimates developed by Cheyenne LF&P (Cheyenne LF&P 1982). Baseline and peak-demand forecasts for Kimball were based on a 3-percent annual growth rate forecast by the Nebraska Public Power Pool, Kimball's chief supplier (City of Kimball, personal communication with City Administrator, 1983). The electrical consumption and peak-demand forecasts used for Wheatland, and the peak-demand forecast for Pine Bluffs were developed by their supplier, the Wyoming Municipal Power Agency (1983). Future electrical consumption in Pine Bluffs was generated using a linear regression of the annual consumption during 1978 to 1983. Electrical consumption and peak-demand forecasts for the Wheatland Rural Electric Association (REA) substation serving Chugwater do not exist. Examination of the data for the 1978 to 1983 period reveal essentially no change in each factor, 1982 values were projected to the year 1990 by assuming a rate of growth of 1 percent per year and provides the basis for an evaluation of the No Action Alternative.

Subsequently, a wholesale cost impact analysis was conducted for Cheyenne based on Cheyenne LF&P's current wholesale contract with PP&L. The analysis concentrated on Cheyenne since project-related percentage increases in consumption and peak demand were greater for this area as indicated in

Section 3.1.1.1. A "nonfirm" wholesale power contract for the City of Kimball is currently in effect. A realistic future wholesale cost analysis comparable to that done for Cheyenne was not possible since Kimball does not have a contract for firm power and therefore is faced with no ratchet charges. Similarly, neither Wheatland nor Pine Bluffs have ratchet charges with their supplier.

### 3.1.1.3 Proposed Action

Project-induced impacts on annual electricity consumption and peak demand for the impacted communities were estimated based on induced population projections. A housing analysis performed on these population projections (see the Socioeconomic EPTR) was used to determine the number of households resulting from the population influx. Each household was assumed to represent one new residential customer. In addition, commuting workers were assumed to occupy motel rooms and/or campsites at the rate of 1.5 per room. A brief survey of energy consumption by major motels in the Cheyenne area found that the per room electrical consumption rates varied dramatically due partially to the fact that peripheral services such as lobby, dining room, bars, conference rooms, gas stations, etc. could not be broken out. Therefore, each room occupied by commuting workers was conservatively assumed to result in the same electrical demand as one residential customer. Peak-year, project-induced residential customer increases were compared to baseline residential customers in that year to gauge the impact of customer addition on the local electrical systems.

The annual increases in residential electricity consumption as a result of the project were formulated based on the annual average consumption values shown in Table 2.6.2-2. These average consumption levels were supplied by the utilities. Project-associated annual residential peak demand was estimated by multiplying annual induced population by 0.5 kW, an amount reflective of local demand characteristics (Cheyenne LF&P 1983).

Project-related residential consumption and peak-demand increases were added to overall baseline figures to reach annual totals and percentage increases. Project-induced wholesale electrical charges were estimated in the same manner as described in Section 3.1.1.2.

### 3.1.2 Natural Gas

#### 3.1.2.1 Selection of the Area of Concentrated Study

The same approach described in Section 3.1.1.1 (electricity) was used here in defining the communities selected for more detailed analysis of natural gas impacts. Due to its higher population influx (Table 3.1.1-1), Cheyenne, Wyoming was initially selected. In addition, mean annual residential consumption figures for each community were applied to peak-year population influx figures to calculate secondary gas consumption (Table 3.1.2-1). The induced consumption figures were then compared to 1982 total natural gas consumption for each community (again, a conservative approach). The communities of Kimball, Torrington, Wheatland, and Pine Bluffs face induced increases in natural gas use varying between 2.5 and 9 percent and are carried forward for detailed analysis in Section 3.5.2. Impacts to the natural gas distribution systems of the remaining communities in Table 3.1.2-1 are not considered potentially important.

Table 3.1.2-1

## PRELIMINARY ANALYSIS - NATURAL GAS

<u>Town</u>	<u>1982 Consumption MCF</u>	<u>Average Residential Consumption: MCF</u>	<u>Peak Induced Population</u>	<u>MCF Gas Induced</u>	<u>% 1982</u>
Kimball	279,930	128	300	13,340	4.8
Gering	478,210	112	115	4,592	1.0
Scottsbluff	1,178,621	125	235	10,125	0.9
Torrington	388,820	117	225	9,243	2.4
Wheatland	313,841	125	475	21,500	6.9
Cheyenne	14,191,417	129	2,650	86,946	0.6
Pine Bluffs	80,331 <sup>a</sup>	a	150	7,482	9.3
Chugwater	No natural gas system		50	--	--

Note: a Included under Cheyenne.

### 3.1.2.2 Baseline Future - No Action Alternative

Cheyenne LF&P supplied estimates of future increases in natural gas consumption for the Cheyenne area (Cheyenne LF&P 1983). Kansas/Nebraska Natural Gas Company, Inc. (K/N) supplies the remaining communities and estimated annual growth at 3 percent (K/N, personal communication with Vice President of Operations, 1983). This factor was applied to the 1982 consumption figures for Kimball, Torrington, and Wheatland. No projection exists for Pine Bluffs. Examination of the past 5 years of natural gas consumption reveals no pattern. Therefore, the 1982 figure was increased at the rate of 1 percent per year through the year 1990. This is in line with the rate of population growth for the town in the Socioeconomics EPTR.

### 3.1.2.3 Proposed Action

Project-induced increases in natural gas use were estimated in a manner similar to that described for electricity (Section 3.1.1.3). The housing analysis conducted on the population projections (see the Socioeconomic EPTR) supplied the total number of residences induced by the project. These were then assumed to be potential new residential gas customers. Although this is not strictly the case (some of the immigrants will be moving into existing, but currently vacant, residences which are already heated during the winter) the assumption does err on the conservative side. Not all residences are heated by natural gas. In Cheyenne, 82 percent of homes use natural gas (Cheyenne LF&P 1983) while the figure is put at 90 percent in the K/N service area (K/N 1983). These factors were applied to the number of project-induced residences in the Area of Concentrated Study (ACS) towns to derive the number of new gas customers. Average gas consumption values shown in Table 3.1.2-1 were applied to calculate the amount of project-induced consumption. It should be noted that for Cheyenne the 1981 to 1982 winter was measured to be within 4 percent of the average in terms of heating degree-days (Table 2.6.3-2). Thus, the 1982 residential gas use figures are reasonably representative of mean annual use.

### 3.1.3 Petroleum Products

#### 3.1.3.1 Selection of the Area of Concentrated Study

Bulk fuel requirements for project construction will likely be purchased from local wholesalers in the larger towns of the ROI: Cheyenne and Scottsbluff. However, substantial fuel purchases can be expected from retailers throughout the DA. Therefore, the ACS is the five-county DA (Goshen, Platte, and Laramie counties in Wyoming and Banner and Kimball counties in Nebraska) plus Scotts Bluff County, Nebraska. Unlike electricity and natural gas, fuel delivery is not wholly dependent upon a fixed infrastructure. Sufficient fuel outlets exist in the ACS to serve existing demand. Fuel deliveries by truck allow for the local fuel distribution system to quickly respond to construction needs from many points in and around the DA. Thus, a relatively large ACS (and fuel supply base) is a reasonable level for analysis.

#### 3.1.3.2 Baseline Future - No Action Alternative

Estimates of total passenger vehicle miles traveled in each of the six counties were available from the Wyoming Highway Department (1982) and the

Nebraska Department of Roads (1983). These were broken down to a number of road categories (rural, urban, and interstate). As of this writing, Nebraska had compiled data for 1982 while Wyoming's latest data were for 1981. To project future miles traveled, the following yearly growth factors are applied:

<u>Road Category</u>	<u>Wyoming</u>	<u>Nebraska</u>
Rural Interstates	1.04	1.03
Rural State Highways	1.025	1.025
County Roads	1.01	1.01
Urban Roads	1.01	1.01

The summation of all road categories in a county represents the total vehicle miles driven for that year in the county. Further information on this methodology may be found in the Transportation EPT, Section 3.1.1.2.1.1.

The total miles traveled figures were converted to gallons of gasoline by the use of national projections of average miles per gallon and fleet composition as reproduced in Table 3.1.3-1. Diesel fuel projections were handled differently since the great majority of its uses are for agriculture, long-distance trucking, railroads, and other industrial needs not reflected in passenger auto mileage projections. Statewide per capita diesel consumption figures were calculated from 1983 data. These figures are 200 gallons per year in Wyoming and 90 gallons per year in Nebraska (Section 2.6.4.3). Diesel use projections were then calculated by multiplying the per capita annual consumption rates by the projected county populations.

### 3.1.3.3 Proposed Action

Total fuel consumption due to project construction were developed by use of standard construction estimating techniques. Figures were provided for both F.E. Warren AFB and the DA. Gasoline and diesel fuel breakdowns were derived by assuming construction at F.E. Warren AFB would require a 25-percent diesel and a 75-percent gasoline split. Construction in the DA was assumed to require a 75-percent diesel and a 25-percent gasoline split.

Induced diesel consumption was calculated by first calculating baseline diesel usage for passenger cars in a manner similar to that described above for gasoline and by use of Table 3.1.3-1. Since projections of national fleet fuel efficiency for diesel cars were not available, a constant 30 miles per gallon was assumed. Induced diesel fuel consumption was then calculated to be the same percentage of baseline passenger auto diesel use as the induced population was to the baseline population. This method carries the implicit assumption that the driving habits and diesel auto preferences of the existing and the induced population are roughly the same.

Fuel estimates for the two DA road upgrades were calculated from per mile diesel fuel consumption factors for the three basic types of upgrades.

Table 3.1.3-1  
AVERAGE AUTO FUEL EFFICIENCY AND FLEET COMPOSITION

	<u>Miles Per Gallon - Gasoline</u>	<u>% Diesel</u>
1983	17.6	2.0
1984	18.4	2.5
1985	19.4	3.0
1986	20.4	3.8
1987	21.5	4.5
1988	22.7	5.3
1989	23.8	6.0
1990	25.0	6.7

Source: Energy and Environmental Analysis, Inc., 1983.

Standard construction estimating techniques for finished roads of the dimension specified for this project were used to develop the following factors:

- o Asphalt overlay of existing asphalt road - 2,320 gallons per mile;
- o Gravel upgrade of existing gravel road - 3,530 gallons per mile; and
- o Asphalt upgrade of existing gravel road - 5,850 gallons per mile.

It is assumed that the immigrants will have approximately the same driving habits, on the average, as the baseline population. Therefore, the induced gasoline and diesel fuel use is calculated to be the same percentage of baseline consumption as the percent increase in population induced by the project. The resulting consumptions were combined with project construction fuel figures to obtain total project-related gasoline consumption.

### 3.1.4 Coal

#### 3.1.4.1 Selection of the Area of Concentrated Study

The only location that will be potentially impacted by the project, in terms of added coal consumption, is F.E. Warren AFB. F.E. Warren AFB has an existing coal-fired heating plant that supplies heat to most of the buildings on the base.

#### 3.1.4.2 Baseline Future - No Action Alternative

No methodology for estimating baseline consumption of coal has been applied. In the absence of the project, coal use at F.E. Warren AFB will continue at the existing level (F.E. Warren AFB Civil Engineering Office 1983).

#### 3.1.4.3 Proposed Action

In order to estimate direct impacts on coal consumption from the project, an estimate of 1,300 tons additional operational coal use is compared to existing levels of use for F.E. Warren AFB. This estimate was derived from a heating load study conducted on the new buildings to be constructed at the base. These figures are also compared to regional consumption levels to gauge the significance of the project-associated operational estimate.

No analysis of project construction or population-induced coal use is carried out since there will be no coal consumption associated with these factors.

### 3.2 Assumptions and Assumed Mitigations

#### 3.2.1 Assumptions

As part of the environmental analysis of potential impacts on energy resources from the project, several assumptions have been made, including:

- o Western Area Power Administration (WAPA) will supply the increased F.E. Warren AFB operational needs for electricity associated with the project. Therefore, F.E. Warren AFB direct operational consumption of electricity will not impact local electricity capacity, supply, or price.

- o In the preliminary analysis of induced consumption of energy (Section 3.1), it was assumed that current (1982) per capita energy consumption rates would remain constant over the entire construction and deployment time period. This is a conservative assumption, since national trends are toward a reduction of per capita energy use. Therefore, the resulting analysis may overstate the magnitude of the project-induced impact.
- o Since socioeconomic analysis projects that immigrants will be living in towns or cities in the ROI, it is assumed that indirect energy needs in the rural areas as a result of the project will be negligible.
- o All indirect electrical demand in the Cheyenne area due to the project will be subject to the ratchet charge portion of Cheyenne LF&P's contract with PP&L.
- o Adequate petroleum supply will be available at the regional and national level through 1990.

### 3.2.2 Assumed Mitigations

In analyzing energy impacts, the following mitigation measures are assumed during and following the construction period:

- o Energy planning will be coordinated with local and/or regional suppliers to ensure a timely and efficient energy supply.
- o Air Force energy conservation design requirements will be incorporated into all new buildings.
- o Onbase electrical needs for construction will be drawn from existing base electrical facilities. Construction electrical requirements will therefore be furnished directly through one or more regional suppliers. Direct, onbase consumption of electricity during project construction will not impact local electricity capacity, supply, or price.
- o In digging and laying the buried communication cables, special care will be taken to avoid damage or interruption to buried energy pipelines. The cable will be buried a minimum of 36 inches below the bottom of all existing pipelines.
- o The upgrading of the WAPA electrical substation required to meet future demand of F.E. Warren AFB will be accomplished as part of the proposed project.
- o In the DA, where temporary construction requirements for electricity exceed the capacity of the local commercial supply, mobile electric generators will be used.

### 3.3 Level of Impact Definitions

The levels of impact (LOIs) are formulated in terms of project-induced change in projected baseline energy use. Separate assessments are made for the short-term project construction period (1984 to 1989) and the long-term post-construction period (1990 and on). Each of the major energy resources (electricity, natural gas, petroleum products, and coal) are evaluated separately. Three major criteria are used in evaluating the impact for each resource:

- o Change in energy demand, including need for new facilities to satisfy the change;
- o Change in price of the energy resource resulting from the project; and
- o Degradation in the service level of the energy resource if it is determined that existing facilities are near capacity.

In addition, the extent of depletion of nonrenewable energy resources is characterized and considered as another criteria.

The LOIs are similar for the four energy resources and are defined as follows:

- o Negligible Impact - No appreciable increase in energy demand would be caused by the project. Price and reliability of the energy resource are unaffected. No depletion of nonrenewable energy resources would result.
- o Low Impact - An increase in demand would be caused by the project. However, existing and planned facilities and/or supplies would be adequate to handle the increase. The cost of the resource may rise, but by such a small amount that the increase would be imperceptible to the average consumer. Reliability of service would be unaffected. Only a minor depletion of nonrenewable energy resources would result.
- o Moderate Impact - The increase in energy demand resulting from the project would cause one or more of the following: 1) the construction of minor new facilities such as additional local transmission lines, small electric transformer sites, local extensions of gas mains, or sizable increases in demand upon local private distributors of diesel and gasoline; 2) price increases large enough to be noticeable by the average consumer, but without appreciable economic hardship; or 3) deterioration in service reliability over the long term or periodic interruptions of service. With regard to nonrenewable energy resources, the depletion is of a magnitude that might spur additional regional energy development.
- o High Impact - The increase in energy demand resulting from the project would cause one or more of the following: 1) the increase in energy demand exceeds the planned capability of a regional, wholesale supplier to provide the energy; 2) a need for major new facilities by the local utility to generate or distribute the additional energy (e.g., large electrical generators, high voltage

transmission lines, major new gas mains, or major storage and distribution equipment for fuel suppliers); 3) an increase in energy price, resulting in hardship to low-income persons or a reduction in energy-dependent economic activities; or 4) substantial service deterioration or frequent interruptions of service. With regard to nonrenewable energy resources, a major depletion would result. The energy resource depletion would be of a magnitude that would necessitate a substantial increase in regional energy development and/or the substitution of alternative energy sources.

### 3.4 Significance Determinations

In addition to LOI, an assessment will be made concerning the significance of identified energy impacts. A significant impact is an impact which warrants heightened attention toward the application of mitigation measures to reduce its effect. The criteria for determining the significance of an energy impact are:

- o The impact affects public health or safety;
- o The impact is likely to be highly controversial;
- o The action and its impact threaten the violation of some federal, state, or local law or requirements imposed for the protection of the environment;
- o Institutional responses to the impact will be extensive; and
- o The impacts to the resource user are, in the judgment of the analyst, of such intensity or geographic coverage as to adversely affect the quality of life in the region or greatly reduce the availability of that resource; the rationale for this judgment will be explicitly stated.

### 3.5 Environmental Consequences of the Proposed Action and No Action Alternative

#### 3.5.1 Electricity

##### 3.5.1.1 Baseline Future - No Action Alternative

The ACS for electricity is Kimball, Wheatland, Pine Bluffs, Chugwater, and the Cheyenne Area (Section 3.1.1.1). Table 3.5.1-1 shows the consumption and peak demand projected by Cheyenne LF&P through 1990 (Cheyenne LF&P 1982). Between 1983 and 1990, electrical consumption is projected to increase 19 percent to nearly 600 million kWh per year, with peak demand increasing 18 percent to slightly over 101 MW. The growth in new residential customers will range from 220 in 1983 to 630 in 1989. Currently, Cheyenne LF&P is avoiding the imposition of wholesale ratchet charges by PP&L by purchasing nonfirm power from the WAPA. This policy will be pursued in the future, assuming available power from regional electrical producers can be obtained. The only major expansion plans involve doubling the capacity of the south side substation in Cheyenne and the installation of an associated feeder line.

Table 3.5.1-1  
CHEYENNE ELECTRICITY PROJECTIONS (CHEYENNE LF&P)

	1983	1984	1985	1986	1987	1988	1989	1990
Baseline Population	60,781	61,642	62,508	63,376	64,243	65,110	65,977	66,844
Baseline Rate of New Residential Customer Addition	224	286	604	494	592	580	633	596
Baseline Forecasted Consumption (kWh)	502,700,000	517,700,000	532,700,000	546,600,000	559,400,000	572,300,000	584,000,000	595,800,000
Baseline Forecasted Peak Demand (kW)	86,300	88,500	91,200	93,600	95,700	97,500	99,700	101,600
Induced Population	-	300	1,425	2,400	2,650	2,450	2,325	1,200
Induced Rate of New Residential Customer Addition	-	94	343	307	60	-68	-34	-335
Induced Residential Consumption (kWh)	-	587,500	2,731,250	4,650,000	5,025,000	4,600,000	4,387,500	2,293,750 <sup>a</sup>
Induced Residential Peak Demand (kW)	-	150	356	1,200	1,325	1,225	1,163	600

Note: a Long-term electrical use induced by project operation.

Projections in the growth of electrical use in Kimball are shown in Table 3.5.1-2. Between 1983 and 1990, electrical consumption is forecast to increase 15 percent to nearly 21 million kWh. Peak demand will also increase by 15 percent to 4.7 MW. The growth in new residential customers will stay constant at about four per year, except for 1984. Major system improvements consist of a new, 10,000 kilovolt ampere (kVA) substation and 6 miles of 115 kilovolt (kV) powerline.

Table 3.5.1-3 shows the consumption and peak demand projected by the Wyoming Municipal Power Agency for Wheatland through 1990 (Wyoming Municipal Power Agency 1983). Between 1983 and 1990, electrical consumption is forecast to increase to over 32 million kWh. Peak demand will increase 23 percent to 6,200 kW. The growth in new residential customers will stay constant at about 40 per year.

Between 1983 and 1990, electrical consumption in Pine Bluffs is forecast to reach 12.6 million kWh (Table 3.5.1-4). Peak demand will increase by approximately 31 percent to 2,400 kW. The growth in new residential customers will stay constant at about five per year. There are plans in the near future to upgrade the substation serving the town. Existing capacity will be doubled to 3,750 kVA.

Table 3.5.1-5 shows the consumption and peak demand for Chugwater through 1990. Between 1983 and 1990, electrical consumption is forecast to increase to nearly 8.8 million kWh. Peak demand will also increase 7 percent to 1,600 kW. The growth in new residential customers in the Chugwater area will stay constant at about four per year. The substation serving the Chugwater area has a capacity of 5,000 kVA, more than double the forecasted load. There are no plans for any major systems improvements.

### 3.5.1.2 Proposed Action

#### 3.5.1.2.1 Direct Impacts

Construction needs at F.E. Warren AFB will consume a total of approximately 2.27 million kWh. The great majority of this construction power will be consumed during 1985 and 1986. If it is assumed that consumption is evenly split over these 2 years, single-year consumption will be 1.14 million kWh which is 5 percent of existing consumption for the base. Peak demand for construction will not exceed 1,000 kW (25 percent of existing peak demand). Power for base construction will be supplied from existing base electrical facilities which means that a regional supplier (WAPA) would be supplying the power. However, WAPA may not be able to supply electrical power for construction. Its firm generation capacity is fully committed to existing users. The agency is willing to allow use of its transmission facilities to wheel construction power supplied by another regional producer to the base (WAPA 1983) if it is unable to supply the power.

Long-term increases in operational requirements for electricity at the base will be approximately 6.13 million kWh annually. This represents a 26-percent increase over 1982 levels. Peak-load requirements would increase by 2,230 kW, or 57 percent over existing conditions. WAPA's firm power supply is fully committed in existing contracts. As existing WAPA supply contracts come up for renegotiation in the late 1980s, the Air Force can apply for the

Table 3.5.1-2

## KIMBALL ELECTRICITY PROJECTIONS

	1983	1984	1985	1986	1987	1988	1989	1990
Baseline Population	3,129	3,124	3,116	3,110	3,101	3,092	3,083	3,072
Baseline Rate of New Residential Customer Addition	4	-	4	4	4	4	4	4
Baseline Forecasted Consumption (kWh)	18,118,500	18,480,870	18,850,487	19,227,497	19,612,047	20,004,374	20,404,374	20,812,461
Baseline Forecasted Peak Demand (kW)	4,100	4,182	4,266	4,351	4,438	4,527	4,617	4,710
Induced Population	-	-	-	-	75	75	300	-
Induced Rate of New Residential Customer Addition	-	-	-	-	50	-22	85	-113
Induced Residential Consumption (kWh)	-	-	-	-	302,000	169,120	682,520	-
Induced Residential Peak Demand (kW)	-	-	-	-	37.5	37.5	150	-

Table 3.5.1-3  
WHEATLAND ELECTRICITY PROJECTIONS

	1983	1984	1985	1986	1987	1988	1989	1990
Baseline Population	4,520	4,620	4,720	4,820	4,930	5,050	5,190	5,310
Baseline Rate of New Residential Customer Addition	8	39	39	39	43	47	55	47
Baseline Forecasted Consumption (kwh) <sup>1</sup>	26,500,000	27,300,000	28,100,000	28,900,000	29,800,000	30,700,000	31,600,000	32,600,000
Baseline Forecasted Peak Demand (kw) <sup>1</sup>	5,034	5,190	5,347	5,507	5,673	5,843	6,018	6,199
Induced Population	-	-	225	475	200	-	-	-
Induced Rate of New Residential Customer Addition	-	-	132	59	-94	-97	-	-
Induced Residential Consumption (kwh)	-	-	792,000	1,146,000	582,000	-	-	-
Induced Residential Peak Demand (kw)	-	-	113	238	100	-	-	-

Source: 1 Wyoming Municipal Power Agency, 1983.

Table 3.5.1-4

## PINE BLUFFS ELECTRICITY PROJECTIONS

	1983	1984	1985	1986	1987	1988	1989	1990
Baseline Population	1,117	1,130	1,144	1,158	1,172	1,186	1,200	1,215
Baseline Rate of New Residential Customer Addition	5	5	5	5	5	5	5	6
Baseline Forecasted Consumption (kWh) <sup>1</sup>	9,600,000	10,000,000	10,400,000	10,600,000	11,200,000	11,700,000	12,100,000	12,600,000
Baseline Forecasted Peak Demand (kW) <sup>1</sup>	1,820	1,895	1,970	2,015	2,130	2,220	2,300	2,400
Induced Population	-	-	-	25	-	150	-	-
Induced Rate of New Residential Customer Addition	-	-	-	17	-17	58	-58	-
Induced Residential Consumption (kWh)	-	-	-	102,000	-	348,000	-	-
Induced Residential Peak Demand (kW)	-	-	-	12.5	-	75	-	-

Source: 1 Wyoming Municipal Power Agency, 1983.

Table 3.5.1-5  
CHUGWATER ELECTRICITY PROJECTIONS<sup>1</sup>

	1983	1984	1985	1986	1987	1988	1989	1990
Baseline Population	230	240	250	260	270	280	290	300
Baseline Rate of New Residential Customer Addition	4	4	4	4	4	4	4	4
Baseline Forecasted Consumption (kWh)	8,188,000	8,270,000	8,353,000	8,437,000	8,521,000	8,606,000	8,692,000	8,779,000
Baseline Forecasted Peak Demand (kW)	1,491	1,506	1,521	1,536	1,551	1,567	1,583	1,599
Induced Population	-	-	50	50	50	-	-	-
Induced Rate of New Residential Customer Addition	-	-	22	0	0	-22	-	-
Induced Residential Consumption (kWh)	-	-	132,000	132,000	132,000	-	-	-
Induced Residential Peak Demand (kW)	-	-	25	25	25	-	-	-

Note: 1 These figures are for the Chugwater substation which serves Chugwater and the surrounding area.

additional electricity needed to meet the increased operational needs of F.E. Warren AFB.

Being a federal installation, F.E. Warren AFB will probably be able to qualify for the generally cheaper WAPA-supplied electrical power over the long term. Without any increase in WAPA's generating capabilities, the increased operational requirements for electricity at F.E. Warren AFB, if supplied by WAPA, would mean a 0.03-percent decrease in availability of this relatively cheap power to existing public power utilities and other consumers presently served by WAPA. The long-term impact to customer electrical costs will therefore be negligible. In fact, WAPA is planning capacity additions totaling over 800 MW by 1985 (WAPA 1981). In addition, projects to expand generating capacity by an additional 7,000 MW are being studied. It is therefore likely that if the request for an additional 2.5 to 3.0 MW of power for F.E. Warren AFB is approved by WAPA, no equivalent reductions in power supply will need to be absorbed by existing contract holders.

Prior to contract renegotiation with WAPA in the latter part of the decade, the Air Force may need to seek a separate supply contract from a regional supplier to supply the increased power needs for several years following base construction.

The WAPA substation currently supplying F.E. Warren AFB will be upgraded from the present 7,200 kVA to between 10,000 and 12,000 kVA to handle the increase in electrical load. Plans are also being made to ground the substation to prevent power outages due to lightning strikes. This upgrade results in a moderate, not significant impact to the local electrical supply system.

None of the three onbase road construction alternatives involve appreciable electrical impact.

Electrical requirements for construction in the DA will be 1.5 million kWh. If it is assumed that virtually all of this will be used for Launch Facility (LF) modification, each modification will require 15,000 kWh of electricity. After the modification process is underway, it is expected to take about 2 months to complete an individual LF modification. Thus, approximately 7,500 kWh per month will be consumed during modification. Electrical consumption in 1982 averaged 180,000 kWh per LF over the 200 LFs operated by F.E. Warren AFB. This computes to an average of 15,000 kWh per month, which is double that during LF modification.

Peak construction electrical demand during modification at each LF is estimated at 125 kW and may exceed transformer capacity for a short period of time, particularly during winter, when electric heaters will be operating below ground. This will occur only when several types of heavy power consuming equipment are operated simultaneously: electric heaters, power grinders, and welding equipment. To avoid overloading the local power supply in such a situation, the contractor will be required to provide supplementary power using a portable generator. Alternatively, the contractor will have the option of requesting from the local REA a temporary transformer and meter with sufficient capacity to meet peak construction demands, as has occurred during past construction on the LFs. In this latter case, specific approval of the affected electrical utility will be required and the contractor will pay for the installation and the removal of the larger temporary transformer. The

utility will not incur any cost burden. Since no more than two or three LFs will be producing these peak loads during any single period of time, no impact upon the local distribution system is expected other than the transformer serving these sites themselves, as discussed above.

Since electrical consumption at a LF will be cut in half during the modification period, the rural electric companies will experience a decrease in electrical sales to the Air Force. Table 3.5.1-6 shows the baseline projections of electric power sales by the three REAs. Also contained in the table is an estimate of the lost power sales due to scheduled LF modification between 1986 and 1989. The highest single-year loss is calculated to be 0.35 percent for the Rural Electric Company in 1988. It is doubtful that this small loss will be noticeable by the utility. Impact of project construction upon the REAs is therefore expected to be negligible.

Over the long term, the operational requirements for electricity at each LF modified to accept a missile will increase from the current average of 180,000 kWh per year to about 219,000 kWh per year, an increase of 22 percent. Peak demand at each LF will be 32 kW. Existing power service to each LF is adequate to meet this need and no new facilities will have to be installed.

In the DA some local powerlines may have to be raised to allow passage of the taller stage transporter (S/T). These lines will be identified further in the planning process and raised at government expense in cooperation with the affected power utilities. If local power outages result from these line raisings, they will be short, lasting from a few hours to at most one working day. Prior notice will be given to customers affected by the temporary power outage. No other disruption of energy service will occur offbase as a result of the project.

There will be no electrical consumption associated with laying the five buried cables. Analysis using Figure 2.6.2-2 indicates that the individual easements or corridors cross from zero to two high-voltage transmission corridors each. By coordinating with the powerline owners, no impact will occur. Therefore, no electrical impact from any of the 11 buried cable alternatives is envisioned. The electrical needs of the small, portable building located at each of the dispatch stations are a negligible fraction of total project consumption.

#### 3.5.1.2.2 Indirect Impacts

Results of the analysis on electrical consumption and peak demand for the ACS indicate that during the peak construction period (1986 to 1987), project-induced consumption in Cheyenne will total approximately 5 million kWh compared to a baseline total of 559 million kWh (Table 3.5.1-1). Increases in peak demand during the peak construction year in Cheyenne will total approximately 1,325 kW compared to a total baseline peak-demand capacity of 95,700 kW. These represent increases of 0.9 percent and 1.4 percent over baseline for electrical consumption and peak demand, respectively.

In Kimball, during the peak year, electrical consumption increases in 1989 will total approximately 682,500 kWh, compared to baseline consumption of 20.4 million kWh (Table 3.5.1-2). The increase in peak demand in Kimball

Table 3.5.1-6

PROJECTED ELECTRICAL SALES BY THE RURAL ELECTRIC ASSOCIATIONS  
(Millions of kWh)

	1983	1984	1985	1986	1987	1988	1989	1990
Rural Electric Co.	160	160.5	161	161.5 (-0.06)	162	162.5 (-0.35)	163 (-0.28)	163.5
Wheatland REA	86	91	93	96 (-0.15)	99 (-0.23)	102	105	108
Wyrulec Electric Co.	96	98	101	160 <sup>a</sup>	182 <sup>a</sup> (-0.22)	184 (-0.12)	186	188

Note: The number in parentheses indicates the short-term percentage power sales losses due to LF modification.

a Large, new industrial customer.

Sources: Wheatland Rural Electric Association 1983.  
Wyrulec Electric Company 1983.  
Rural Electric Company 1983.

during the peak construction year will be approximately 150 kW over the baseline peak-demand capacity of 4,617 kW. These figures represent project-induced increases of 3.3 percent and 3.2 percent over baseline for electrical consumption and peak demand, respectively.

During the peak construction period (1985 to 1986), project-induced consumption in Wheatland will total approximately 1.1 million kWh compared to a baseline total of 25.4 million kWh (Table 3.5.1-3). Increases in peak demand during the peak construction year in Wheatland will total 238 kW compared to a total baseline peak demand of 6,200 kW. These represent increases of 4.3 percent and 4.5 percent over baseline, respectively.

In Pine Bluffs during the peak year (1988), electrical consumption increases will total approximately 348,000 kWh, compared to baseline consumption of 8.4 million kWh (Table 3.5.1-4). The increase in peak demand in Pine Bluffs during the peak construction year will be 75 kW over the baseline peak demand of 2,220 kW. These figures represent project-induced increases of 4.1 percent and 3.4 percent over baseline, respectively.

During the peak period of immigration for Chugwater (1985 to 1987), project-induced consumption will total approximately 132,000 kWh per year compared to a baseline total of 8.3 million kWh (Table 3.5.1-5). Increases in peak demand during this period will total 25 kW compared to a total baseline peak-demand capacity of 1,500 kW. These represent increases of 1.6 percent over baseline of electrical consumption and peak demand, respectively.

During the first year of project-induced population influx to Cheyenne in 1984, the rate of new customers for Cheyenne LF&P is estimated to increase from 286 to 380 for that year only (Table 3.5.1-1), a 33-percent increase. During 1985 and 1986, project-induced new customers will increase to over 300 per year. This represents a 60-percent increase in residential hookup requests for those years. Due to this increased customer load, customer service may deteriorate somewhat over this 2 to 3-year period (Table 3.5.1-1). As project construction activity declines during 1988 to 1990 customers will be lost. However, this loss of project-related residential customers will be more than offset by the baseline customer increases (Table 3.5.1-1).

In Kimball, approximately 110 new residential customers will result from the project during the 1987 to 1990 time period. In 1987, residential customers will increase from 4 to 54 for that year only. As construction activity declines in 1988, a loss of 28 project-related customers will result. During the following year, new residential customers will increase by 85 over baseline due to renewed project activity (Table 3.5.1-2). This increased customer load which represents a 7-percent increase in total customers, may have a slight negative effect upon the current level of electrical service during 1987 and 1989. Following the end of construction in the DA in 1989, the Kimball utility can expect to lose about 110 residential customers.

During the first year of project-induced population influx to Wheatland in 1985, the rate of new customers is estimated to increase from 39 to 171, a 338-percent increase. Again, customer service may be slightly impacted during this peak year. The subsequent annual increase will decline to 50 percent over baseline (Table 3.5.1-3). As project construction activity declines

after 1986, loss of project-related customers will be balanced by baseline increases in new customers by 1990.

In Pine Bluffs, approximately 60 new residential customers will result from the project during the 1986 to 1988 time period, representing an increase of about 9 percent. Such an increase may result in deteriorated customer service during the peak year of project-induced customer additions, 1989 (Table 3.5.1-4). These customers will be lost following project completion in late 1989. In Chugwater, approximately 22 new project-induced residential customers will be added to baseline customers in the peak year of construction (1985).

Based on existing and projected supply and capacity conditions of Cheyenne LF&P and the City of Kimball Electrical Department, the two utilities will be able to adequately serve the projected amount of new residential customers resulting from the project. In addition, the small percentage of additional peak-demand requirements will not adversely affect overall utility capacity in either case.

Pine Bluffs and Wheatland have served considerably larger populations in the past. In the early 1970s, the Minuteman III silo upgrade project brought a sizable, temporary population increase to Pine Bluffs. The service line which served much of that population at a temporary mobile home park could be used again with the installation of a few line transformers (Pine Bluffs, City of, personal communication with staff 1983). The upgrading of the town's substation capacity assures an adequate electrical supply to serve the immigrants. Due to the recent completion of the Laramie River Power Station, Wheatland has considerable, surplus, local electrical capacity in the wake of construction worker departures. From a peak population of about 6,000 the town currently has about 4,500 residents. The loads induced by the project can be readily handled by the town's electrical system (Wheatland, personal communication with City Clerk 1983). Neither utility will be adversely affected.

The Chugwater substation has a 5,000 kVA capacity and operates at a load of only 45 percent (Wheatland REA, personal communication with staff 1983). The 22 additional residential customers induced by the project can be easily handled by the facility.

Results of the wholesale cost impact analysis conducted for Cheyenne indicate that during the peak construction period, wholesale purchases of electricity increase approximately 1.5 percent over baseline. The effect of this increase is that the utility will pay approximately 0.4 percent more per kWh due to potential ratchet charges during the years 1986 to 1989. It appears that project-induced consumption will not significantly increase Cheyenne LF&P's current monthly costs of buying power from PP&L.

The projected increase in wholesale costs should be considered a conservative estimate, since it was assumed that all additional power needs resulting from the project would be purchased from PP&L under the current contract. Cheyenne LF&P is currently receiving power from WAPA at a considerably less expensive wholesale rate, under a 6-month contract (Cheyenne LF&P 1983). The availability of this cheap power, primarily from a hydropower source, may be present in

the future as well. Therefore, wholesale cost impacts may be less than indicated in the above analysis. A 0.4-percent increase in wholesale electrical costs will likely translate to a somewhat lower increase in the electrical rate charged to the customer by the utility. If passed directly to the customer, project-induced rises in electrical bills would raise the yearly costs to the average residential consumer by about 65 cents. In effect, increases in residential electrical rates resulting from the project, if they occur at all, will not be noticeable in the average monthly residential bill. The service extensions required to serve project-induced customers will have no effect upon utility rates (Cheyenne LF&P 1983).

As indicated in Section 3.1.1, a wholesale cost impact analysis for Kimball was not carried out due to the existing "nonfirm" power contract with WAPA currently in effect. Thus, Kimball currently has no demand or ratchet charges. Under Kimball's present contract, there is no cost penalty for increased electrical usage. Therefore, the project will not impact existing customers. At present, the City pays 2.5 cents per kWh for "nonfirm" power. It costs the utility 5.7 cents per kWh to generate power from its own power plant. Under this arrangement, a cost analysis comparable to that performed for Cheyenne LF&P was not possible.

Wholesale cost impact analyses for Wheatland and Pine Bluffs were not prepared as well, since these utilities do not pay ratchet charges to their wholesalers. There is no penalty for increased electrical usage in these areas and the rates paid by existing customers will not be impacted by the project.

The impact of the project upon the electric utilities of Cheyenne, Kimball, Wheatland, Pine Bluffs, and the Wheatland REA will be low and not significant over the short term. Cheyenne LF&P will experience a low, not significant impact over the long term due to demand from operational personnel living in Cheyenne.

### 3.5.2 Natural Gas

#### 3.5.2.1 Baseline Future - No Action Alternative

Tables 3.5.2-1 to 3.5.2-5 show the baseline projected increases in natural gas consumption in the five towns which form the ACS (Section 3.1.2.1). Cheyenne LF&P projects an 8-percent increase in consumption between 1983 and 1990, approaching 8,000,000 thousand cubic feet (MCF) annually. This includes natural gas consumption in Pine Bluffs which is served by Cheyenne LF&P. The baseline annual growth in new residential customers range from about 235 in 1984 to 532 in 1990.

Kimball, Torrington, and Wheatland are projected to experience increases of 20 percent to 25 percent in natural gas consumption between 1983 and 1990. Pine Bluffs is projected to experience an increase of about 7 percent during this time period. Annual gas consumption by 1990 will range from 87,000 MCF to 500,000 MCF among the 4 towns. The baseline annual growth in new residential customers ranges from 4 in Pine Bluffs and Kimball to 80 for Torrington.

No major gas storage tanks or transmission mains are planned to serve growth in any of the five towns.

Table 3.5.2-1

## CHEYENNE NATURAL GAS PROJECTIONS

	1983	1984	1985	1986	1987	1988	1989	1990
Baseline Population	65,030	65,730	67,210	68,420	69,870	71,290	72,840	74,300
Baseline Rate of New Residential Customer Addition	184	235	495	405	485	476	519	489
Baseline Forecasted <sup>1</sup> Consumption (MCF)	7,220,000	7,300,000	7,390,000	7,480,000	7,570,000	7,660,000	7,740,000	7,810,000
Induced Population	-	300	1,425	2,400	2,650	2,450	2,325	1,200
Induced Rate of New Residential Customer Addition	-	111	265	250	48	-56	-30	-278
Induced Consumption (MCF)	-	14,319	48,504	80,754	86,946	79,722	75,852	39,990 <sup>a</sup>

Notes: 1 Includes forecasted consumption baseline figures for Pine Bluffs which is served by Cheyenne LF&P.

a Long-term natural gas consumption induced by project operation.

Table 3.5.2-2

## PINE BLUFFS NATURAL GAS PROJECTIONS

	1983	1984	1985	1986	1987	1988	1989	1990
Baseline Population	1,117	1,130	1,144	1,158	1,172	1,186	1,200	1,215
Baseline Rate of New Residential Customer Addition	4	4	4	4	4	4	4	5
Baseline Forecasted Consumption (MCF)	81,135	81,950	82,770	83,600	84,430	85,275	86,130	86,990
Induced Population	-	-	-	25	-	150	-	-
Induced Rate of New Residential Customer Addition	-	-	-	14	-14	48	-48	-
Induced Consumption (MCF)	-	-	-	1,806	-	7,480	-	-

Table 3.5.2-3

## KIMBALL NATURAL GAS PROJECTIONS

	1983	1984	1985	1986	1987	1988	1989	1990
Baseline Population	3,140	3,140	3,150	3,160	3,170	3,180	3,190	3,200
Baseline Rate of New Residential Customer Addition	4	-	4	4	4	4	4	4
Baseline Forecasted Consumption (MCF)	288,328	296,978	305,887	315,064	324,516	334,251	344,277	354,607
Induced Population	-	-	-	-	75	75	300	-
Induced Rate of New Residential Customer Addition	-	-	-	-	45	-19	79	-105
Induced Consumption (MCF)	-	-	-	-	5,760	3,328	13,440	-

Table 3.5.2-4

## TORRINGTON NATURAL GAS PROJECTIONS

	1983	1984	1985	1986	1987	1988	1989	1990
Baseline Population	5,540	5,620	5,700	5,870	6,070	6,260	6,490	6,680
Baseline Rate of New Residential Customer Addition	28	28	28	60	70	67	81	67
Baseline Forecasted Consumption (MCF)	400,485	412,499	424,874	437,620	450,749	464,271	478,200	492,546
Induced Population	-	-	-	-	225	-	-	-
Induced Rate of New Residential Customer Addition	-	-	-	-	79	-79	-	-
Induced Consumption (MCF)	-	-	-	-	9,243	-	-	-

Table 3.5.2-5

## WHEATLAND NATURAL GAS PROJECTIONS

	1983	1984	1985	1986	1987	1988	1989	1990
Baseline Population	4,520	4,620	4,720	4,820	4,930	5,050	5,190	5,310
Baseline Rate of New Residential Customer Addition	7	35	35	35	39	42	50	42
Baseline Forecasted Consumption (MCF)	323,256	332,954	342,943	353,231	363,828	374,743	385,985	397,564
Induced Population	-	-	225	475	200	-	-	-
Induced Rate of New Residential Customer Addition	-	-	119	53	-85	-87	-	-
Induced Consumption (MCF)	-	-	14,875	21,500	10,875	-	-	-

### 3.5.2.2 Proposed Action

#### 3.5.2.2.1 Direct Impacts

No natural gas requirements have been identified for project construction. The only additional natural gas requirements for project operation will be for space heating of six new buildings in the Stage Storage Area (SSA) at F.E. Warren AFB. The probable energy source will be Cheyenne LF&P-supplied natural gas. The annual natural gas requirement will be 2,500 MCF. This is equivalent to about 18 residential dwellings and is considered to be a negligible impact upon the Cheyenne LF&P system.

None of the 11 buried cable corridors will cross any identified natural gas transmission mains. Base road Alternatives R1 and R2 would both cross the 8-inch gas main which enters F.E. Warren AFB at its southeast corner. Proper road construction would avoid any impact to the pipeline. Neither of these activities would involve consumption of natural gas. Overall natural gas impact from any combination of alternatives would be negligible.

#### 3.5.2.2.2 Indirect Impacts

It is projected that during the peak construction period (1985 to 1989), increases in natural gas consumption over baseline will range between about 9 percent in Pine Bluffs to 0.7 percent in Cheyenne (Tables 3.5.2-1 to 3.5.2-5). During the peak construction year in Pine Bluffs, project-induced consumption will total approximately 7,500 MCF compared to the baseline figure of 85,275 MCF, a 9-percent increase (Table 3.5.2-2). During the peak construction year in Wheatland, project-induced consumption will total approximately 21,500 MCF, compared to baseline consumption of 353,000 MCF in that same year, a 6-percent increase (Table 3.5.2-5). In Kimball, project-induced consumption increases over baseline will total 4 percent during the peak construction year (1989). During the peak construction year in Torrington, the increase in project-induced consumption over baseline will be approximately 2 percent (Tables 3.5.2-3 and 3.5.2-4).

The increase in the rate of new customers that the natural gas companies may experience will parallel the experience of the electric utilities discussed in Section 3.5.1.2. Except for the Cheyenne area all project-induced residential customers will depart following project construction. During peak immigration periods, responses to service calls may slow noticeably due to locally large increases in new customer service. This effect will be short term, however.

Based on existing and projected availability of natural gas in the Wyoming and Nebraska areas, and capacities of local suppliers, the gas distributors serving the towns under study will be able to adequately serve the additional customers and the small percentage increases in consumption induced by the project. Cheyenne LF&P recently lost a major industrial consumer, the Wycon Company, a manufacturer of nitrogen fertilizers. Wycon is buying its natural gas directly from another supplier. This has meant a 40-percent reduction (approximately 6,000,000 MCF) in Cheyenne LF&P's natural gas sales. This capacity will be available to serve future customers (Cheyenne LF&P 1983). Table 3.5.2-1 shows that the project-induced demands will be considerably lower than the amount that was formerly sold to Wycon. Given the currently plentiful natural gas supplies available at the regional level, the other

natural gas suppliers will be minimally affected by the projected increases in local consumption due to the project.

Although natural gas prices have risen sharply in recent years, price rises during the next several years should be more moderate (K/N 1983, Greeley Gas Company 1983). Natural gas price increases will continue to be dominated by regional and national supply and demand patterns and pricing mechanisms. None of the local gas purveyors contacted in the ACS indicated that project-induced demand would affect consumer prices. The project will therefore have a low, not significant local impact over the short and long term.

### 3.5.3 Petroleum Products

#### 3.5.3.1 Baseline Future - No Action Alternative

##### 3.5.3.1.1 Gasoline

The ACS includes the six counties of Platte, Goshen, and Laramie, Wyoming and Scotts Bluff, Banner, and Kimball, Nebraska (Section 3.1.3.1). Table 3.5.3-1 indicates a 20-percent decrease in passenger vehicle gasoline consumption between 1983 and 1990. In 1990, consumption will be about 56 million gallons (MG) in the 6-county area. This decrease is due to the increasing efficiency of gasoline use in the automobile fleet through the decade, even though population is also forecast to increase.

##### 3.5.3.1.2 Diesel

Baseline diesel fuel projections are found in Table 3.5.3-2. Diesel consumption in the 6-county area is projected to increase by 12 percent between 1983 and 1990. Consumption in 1990 will be over 25 MG.

#### 3.5.3.2 Proposed Action

##### 3.5.3.2.1 Gasoline

##### 3.5.3.2.1.1 Direct Impacts

Table 3.5.3-3 shows a yearly breakdown of gasoline and diesel requirements for construction. Peak gasoline use will occur in 1985 when 760,000 gallons are consumed. It is assumed that the contractors will purchase their bulk fuel requirements directly from either local wholesalers or a regional source. Impacts on local and regional suppliers due to primary gasoline consumption are discussed as part of total gasoline requirements in Section 3.5.3.2.1.2.

##### 3.5.3.2.1.2 Indirect Impacts

Primary and project-induced gasoline consumption will not raise baseline consumption by an appreciable amount on either a local or regional scale. During peak construction years in the 6-county area, total gasoline consumption will represent an additional 3-percent increase over baseline consumption (Table 3.5.3-1). Regional consumption of gasoline in 1982 for the states of Colorado, Wyoming, and Nebraska totaled over 2.5 billion gallons. Total project-related gasoline needs represent a maximum of 0.1 percent of this regional total in any 1 year, a negligible amount.

Table 3.5.3-1

GASOLINE USE PROJECTION IN THE AREA OF CONCENTRATED STUDY<sup>1</sup>  
(Millions of Gallons)

<u>Consumption by County</u>	<u>1983</u>	<u>1986</u>	<u>1987</u>	<u>1990</u>
Laramie				
Baseline	34	31.2	29.9	27.4
Induced	-	1.03	1.05	.41
Goshen				
Baseline	6.6	5.9	5.7	5.1
Induced	-	-	0.14	-
Platte				
Baseline	9.2	8.6	8.4	7.7
Induced	-	0.34	0.15	-
Kimball				
Baseline	5.3	4.8	4.6	4.2
Induced	-	-	-	-
Banner				
Baseline	1.2	1.1	1.0	.9
Induced	-	-	-	-
Scotts Bluff				
Baseline	13.6	12.3	11.6	10.7
Induced	-	0.02	0.03	-
TOTAL-ACS				
Baseline	69.9	63.9	61.2	56.0
Induced	-	1.39	1.37	.41
Construction	-	.57	.46	.02
Percent Increase Over Baseline	-	3%	3%	0.8%

Note: 1 Passenger vehicle gasoline consumption only.

Table 3.5.3-2

DIESEL USE PROJECTION IN THE AREA OF CONCENTRATED STUDY<sup>1</sup>  
(Thousands of Gallons)

<u>Consumption by County</u>	<u>1983</u>	<u>1986</u>	<u>1987</u>	<u>1990</u>
Laramie				
Baseline	14,093	14,849	15,172	15,155
Induced	-	27.59	35.25	24.32
Goshen				
Baseline	2,426	2,500	2,544	2,576
Induced	-	-	4.71	-
Platte				
Baseline	1,874	1,994	2,038	2,192
Induced	-	9.24	4.99	-
Kimball				
Baseline	436	434	434	433
Induced	-	-	-	-
Banner				
Baseline	82	82	82	82
Induced	-	-	-	-
Scotts Bluff				
Baseline	3,560	3,672	3,708	3,823
Induced	-	.66	0.95	-
TOTAL-ACS				
Baseline	22,472	23,531	23,978	25,361
Induced	-	37.5	45.9	24.3
Construction	-	1,356	1,123	71.0
Percent Increase Over Baseline	-	6%	5%	0.4

Note: 1 Passenger vehicle diesel consumption only.

Table 3.5.3-3

DIRECT FUEL CONSUMPTION  
(Thousands of Gallons)

	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>Total</u>
F.E. Warren AFB									
Gasoline	0	120	491	128	94	68	0	0	901
Diesel	0	40	164	43	31	23	0	0	301
Deployment Area									
Gasoline	0	8	269	438	364	244	268	24	1,615
Diesel	0	23	806	1,313	1,091	731	803	71	4,838
TOTAL:									
Gasoline	0	128	760	566	458	312	268	24	2,516
Diesel	0	63	970	1,356	1,122	754	803	71	5,139

These figures will not adversely impact local or regional gasoline suppliers or distributors. At present, energy-producing and drilling activity is generally below normal levels in Wyoming, primarily due to the economic recession. These activities are energy-intensive, consuming large quantities of fuel during operation. Due to below-normal activity, local and regional gasoline suppliers and distributors currently have an excess of service and supply capacity available for local use (Fleischli Oil Company 1983). If drilling and energy-producing operations resume to normal or above-normal levels, local and regional distributors may be impacted by project-induced consumption in the peak year of construction. However, due to the low levels of project-related increases in consumption, this impact will not be adverse.

Impacts on local and regional retail and wholesale gasoline prices will be negligible. The specific effect cannot be calculated since gasoline price fluctuations are dependent upon national and international petroleum cost factors. Overall project impact will be low at the local level and negligible on the regional level during both the short and long term. All gasoline impacts are not significant.

#### 3.5.3.2.2 Diesel

##### 3.5.3.2.2.1 Direct Impacts

From Table 3.5.3-3 it can be determined that peak year diesel use at F.E. Warren AFB and in the DA will be 1,356,000 gallons in 1986. Similar to the case of gasoline, this will not adversely impact local or regional diesel suppliers or distributors and will therefore not affect retail diesel availability or price. A low, not significant impact to the local direct distribution network will result from the project.

Fuel requirements for road construction at F.E. Warren AFB are assumed to be directly proportional to the length of roads in each of the three alternatives. Alternatives R1 and R3 involve approximately 3 miles of new road onbase while Alternative R2 involves 5 miles. Alternative R2 would presumably result in more fuel use than the other two. However, when compared to the 7.7 MG. of fuel used for the entire project, the difference would be small.

On the average, fuel requirements for cable installation will vary in direct proportion to route mileage. During the construction of buried cable, it is estimated that 3,000 feet per day can be installed. Fuel consumption for the trencher and 2 supporting heavy vehicles is estimated at 210 gallons per day or 370 gallons per mile. Fuel requirements will vary from 480 gallons for PA1 to 9,880 gallons for PD1. Fuel requirements for the 5 proposed cable routes would be 30,270 gallons. The longest acceptable combination of five cable routes would require a third more fuel for construction (40,710 gallons). The fuel impacts of all but one of the buried cable routes are rated low and not significant. Due to its much shorter length and correspondingly lower fuel consumption, PA1 will have a negligible impact.

Option A for the upgrade of DA roads is estimated to consume about 1.8 MG. Option B would consume about 2.7 MG, or 50 percent more diesel fuel. Peak fuel use for road upgrades will be in 1986 when approximately one-half of the upgrade work is accomplished. The regional increases in fuel consumption for either option will have a low, not significant impact upon the fuel distribution system.

The current operational use of diesel fuel (79,000 gallons in 1982) includes consumption by the existing missile transport system for the Minuteman missiles. The Minuteman transporter/erector (T/E) is currently used to transport and position missiles which require removal for replacement or for inspection and maintenance. This vehicle, which makes an average of 60 roundtrips annually to replace 30 missiles, gets 4 miles per gallon. The average roundtrip distance between F.E. Warren AFB and the 100 LFs is 121 miles. This requires an estimated total of 1,815 gallons of diesel fuel per year.

As discussed in Section 1.0 of the EIS, operational use, as a result of the project, will require two vehicles for transport and placement within a silo. A S/T will be used to transport, individually, the four stages of the missile to the silo plus the reentry system. Once a missile stage reaches the LF, it will be transferred to a second vehicle called a stage emplacer for actual placement in the silo.

During Peacekeeper operations, it is projected that 20 missiles per year will be replaced and that an additional 20 reentry systems will be removed and replaced. The former exercise requires ten roundtrips of the S/T per missile changeout while the latter requires two roundtrips. The emplacer makes one roundtrip per missile or reentry system change. It is projected that a total of 280 roundtrips will be required annually as a result of the project, 240 roundtrips for the S/T, and 40 roundtrips for the emplacer. Since the S/T is considerably heavier than the T/E, it will average only about 2 miles to the gallon, as will the emplacer. Again, with an average roundtrip distance of 121 miles, a total of about 17,000 gallons of diesel will be consumed per year. Other operational aspects of the project system are assumed to use the same amount of fuel as the current Minuteman operations.

The increase in diesel fuel use of 17,000 gallons associated with project operations represents a 22-percent addition to long-term operational diesel use over that in 1982. No other increase in fuel use is projected as a result of the project.

#### 3.5.3.2.2.2 Indirect Impacts

Direct plus induced diesel consumption will peak in 1986 at near 1.4 million gallons. This represents a 6-percent increase above baseline conditions. In 1990, long-term operational needs for Peacekeeper will be less than one-half of 1 percent above baseline, and concentrated in the Cheyenne area. The larger construction requirements will be supplied directly by regional and or local wholesalers. The impact upon the existing supply and distribution system will be low and not significant, particularly for the local retailers of diesel. No price impact is anticipated.

#### 3.5.4 Coal

##### 3.5.4.1 Baseline Future - No Action Alternative

No baseline future increase in coal consumption is expected in the ACS (Section 3.1.4.2).

### 3.5.4.2 Proposed Action

#### 3.5.4.2.1 Direct Impacts

As indicated in Section 3.1.4.3, it is assumed that there will be no impacts on coal consumption during project construction. However, subsequent to project construction, operational consumption of coal will increase on F.E. Warren AFB. Coal consumption in 1982 on the base totaled about 10,700 tons. The additional operational use of coal as a result of the project is 1,300 tons annually. This increase will be for space heating for most of the new buildings on the base (approximately 290,000 square feet of floor space). The central heating plant possesses ample capacity to meet this increased heating requirement.

This projected 12-percent increase in coal consumption at F.E. Warren AFB over existing use will represent a relatively small increase that is not expected to cause adverse impacts on local and regional coal suppliers. The projected increase will require approximately 15 to 30 additional coal railcar movements into the local area to supply the added demand. This increase in railroad activity will not result in any adverse impacts.

When compared to 1981 statewide coal consumption figures for Nebraska and Wyoming of 5.3 million tons and 15 million tons, respectively, it is evident that the projected increase is minimal (approximately 0.03% and 0.01%, respectively). Regional suppliers will have adequate capacity to handle the increased demand and will not be impacted.

Due to the extremely small increase in operational coal consumption from the project, no impact on coal prices are expected. Overall impact will be negligible over the short term and low and not significant over the long term at the local level. All regional impacts will be negligible.

#### 3.5.4.2.2 Indirect Impacts

No project-induced impacts on coal resources are anticipated. It is assumed that all energy needs of the induced population will be met by other sources of energy, i.e., electricity, natural gas, and gasoline, and, therefore, no additional consumption of coal will occur.

### 3.6 Summary of Impacts

#### 3.6.1 Impact Matrix

Figure 3.6.1-1 depicts a summary matrix of projected energy impacts under the project. Site-specific impacts are not considered generally applicable to energy supply and impact. Energy supply and distribution systems are locally and regionally organized and it is at these levels that demand and impact from the project would be felt. Thus, site impacts are not assessed. The basis for determining impact levels at the local and regional level has been discussed in the preceding sections and is summarized below. Criteria for determining levels of impact and significance are discussed in Sections 3.3 and 3.4, respectively.



### 3.6.1.1 Electricity

Direct, short-term increases in electricity demand for construction at F.E. Warren AFB will be met by a regional suppliers. Therefore, Cheyenne LF&P will not be impacted by direct project construction, in terms of supply, capacity, or price. Electricity costs to the average consumer will not be affected. Several facility modifications in the DA will result in very minor drops in electrical consumption during 1986 to 1989. The small loss to the three rural electric companies serving the DA should not be noticeable.

Project-induced increases in electricity consumption and peak demand will be approximately 1 percent over baseline consumption in Cheyenne, 1.5 percent in Chugwater, 4 percent in Pine Bluffs, 4.5 percent in Wheatland, and 3.3 percent over baseline in Kimball during the peak construction years (Section 3.5.1). This increase in demand has been determined to be low, since existing and projected supplies will be adequate to handle the increases. The unit cost of wholesale electricity paid by Cheyenne LF&P will increase by a maximum of 0.4 percent baseline during the peak construction year. Electricity costs could increase very slightly as a result of the project. This increase will be imperceptible to the average consumer. There will be no effect upon the price paid for electricity by customers of the other utilities as a result of the project. All of the electric utilities affected by the project reported that existing system facilities were adequate to handle the projected temporary increases in residential customers. One effect of the temporary rise in electric customers may be a short-term increase in response time on the part of the utilities to requests for service calls.

Due to a large increase in electrical load at F.E. Warren AFB following construction, the existing electrical substation will need to be upgraded. Thus, overall short-term electrical impacts are judged to be moderate at the local level and not significant. Long-term electrical needs at F.E. Warren AFB will increase greatly over existing conditions. However, overall local long-term electrical impacts will be low and not significant. Short and long-term regional impacts will be negligible.

### 3.6.1.2 Natural Gas

There will be no direct impacts on natural gas consumption over the short term. Project-induced increases in natural gas consumption will total 1 percent over the baseline consumption in Cheyenne, 4 percent in Kimball, 2 percent in Torrington, 6 percent in Wheatland, and 9 percent in Pine Bluffs during the peak construction years (Section 3.5.2). Since local and regional supplies of natural gas will be adequate to meet the increased demand, overall impacts from project-induced consumption will be low. No increase in the price of natural gas is expected due to the project. The overall short-term impacts are judged to be low and not significant locally, and negligible on a regional level.

The long-term local impact will be a slight increase in the use of natural gas at F.E. Warren AFB to heat several buildings at the new SSA. Other local gas use by additional personnel supporting project operations, will be low. Therefore, there will be a low, not significant local impact over the long term. Once again, impact to the regional supply system will be negligible, both in the short and long term.

#### 3.6.1.3 Petroleum Products

Primary and project-induced gasoline consumption increases will represent an additional 3 to 4 percent over baseline consumption during peak construction years in the ACS. Such increases will result in a low, not significant level of impact since local and regional suppliers and distributors will have adequate capacity to meet demand resulting from the project. Gasoline prices will be unaffected by the project, since prices are set by national and international supply and policies.

Similar to direct gasoline demand, project-related diesel consumption will be minor (6% in the peak year) and will not impact local or regional suppliers or prices. The short-term fuel impacts are judged to be low and not significant locally, and negligible with regard to the regional distribution system.

Long-term increases in fuel used at F.E. Warren AFB will be small. The relative increase in fuel use in the Cheyenne area by the additional personnel associated with the project will also be low. Long-term impact of the project upon petroleum products is judged to be low and not significant locally, and negligible at the regional level.

#### 3.6.1.4 Coal

Short-term use of coal for the project will be negligible. Long-term base operations will result in a 1,300 tons per year (12%) increase in coal consumption at the central heating plant. This is judged to be a low impact at the local level and a negligible impact to the regional supply system over the long term.

#### 3.6.1.5 Depletion of Nonrenewable Resources

Because of the highly developed regional energy distribution system, energy resource depletion is only considered potentially significant at the regional level. In no category does project-related energy consumption account for more than a fraction of 1 percent of the regional supply capacity. Thus, overall impact to the nonrenewable resource base is concluded to be low and not significant over both the long and short term.

#### 3.6.2 Project Alternatives

Figure 3.6.2-1 is a matrix of the impacts resulting from the project-element alternatives. None of the alternatives are expected to consume appreciable amounts of electricity, natural gas, or coal either during construction or operation of the project. Impacts to these energy resources will therefore be negligible.

Diesel fuel will be consumed during the laying of the buried cables and the road construction at F.E. Warren AFB. Their construction represents a small fraction of the total project-construction effort. Fuel impacts will therefore be low for all but one of the alternatives when compared to the total project fuel needs. Fuel needs for PA1 will be negligible due to its appreciably shorter length. The dispatch station alternatives involve negligible fuel needs. All impacts are judged to be not significant.

LEVEL OF IMPACT Measure of the Amount of Environmental Change			Significant Adverse Impacts	Potential Beneficial Effects
Low	Adverse Impacts			
				
Moderate				
High				

**Notes:**

1	Denotes specific cable paths. For location of cable paths see Section 1.1
2	For location of alternative routes see Section 1.1
3	For location of dispatch stations see Section 1.1

**FIGURE NO. 3.6.2-1**

### 3.6.3 Aggregation of Elements, Impacts, and Significance

Overall impact of the proposed project upon energy resources is low and not significant for the short term, and low and not significant for the long term.

In order to determine the overall energy level of impact, an approach was used which composited the individual energy element levels of impact, based on professional judgment and analysis. Since short-term local energy impacts on natural gas and petroleum products are low, the impact on electricity is moderate and the impact on coal is negligible, the resultant composite of the short-term, local impact of the project upon energy resources as a whole is low. A similar procedure was used to determine that the overall energy impact in the long term at local level is also low, while short and long-term regional energy impact due to the project is negligible.

The overall energy impact of the project element alternatives is low and not significant due to the low fuel impacts for the buried cable and base road alternatives (Figure 3.6.2-1).

### 3.7 Mitigation Measures

The following measures are recommended to assure that the project results in a minimum demand on energy resources. One, some, or all of the mitigation measures may ultimately be selected. Each measure identifies the party responsible to implement, but not necessarily to pay for, the measure.

- o Diesel fuel savings can be realized by operating the project missile transport and support equipment to minimize the number of roundtrips needed to replace a missile. This substitution of smaller transport vehicles, where practical, coupled with operational practices which minimize the number of roundtrips required of the S/T can serve to minimize the amount of fuel consumed during yearly operations. This measure should be implemented at the start of the full system operation in late 1989. Earlier implementation would result in less fuel consumed during the Peacekeeper deployment period. This measure will not affect the level of energy impact of the project. The responsible agency for implementing this mitigation measure is the Air Force.
- o Provide project-related employees with incentives for using high occupancy vehicles such as van pools or car pools. This mitigation will be effective in reducing the project-related traffic increase and the attendant fuel consumption and, if selected, should be implemented throughout the construction phase of the project. The responsible agency for implementing this mitigation measure is the Air Force and its contractors.

### 3.8 Unavoidable Adverse Impacts

Induced consumption from worker immigration will not change the national energy consumption picture. It only represents a shift in the location of energy use to a region relatively well endowed with energy resources. Thus, the only adverse energy impacts will result from the consumption of nonrenewable resources resulting from project construction and operation.

### 3.9 Irreversible and Irretrievable Resource Commitments

Direct project energy requirements for construction and operation represent the only irreversible and irretrievable commitment of energy resources required for the project. These requirements are shown in Table 3.9-1.

Table 3.9-1

#### DIRECT ENERGY REQUIREMENTS FOR THE PROPOSED PROJECT

	<u>Construction</u>	<u>Yearly Operation Needs<sup>1</sup></u>
Electricity (kWh)	3.8 Million	10.1 Million
Natural Gas (MCF)	0.0	2,500
Petroleum		
Fuels (gal)	7.65 Million	17 Thousand
Coal (tons)	0.0	1,300

Note: 1 Increase above current operational energy requirements for F.E. Warren AFB and the DA combined.

### 3.10 Relationship Between Local Short-Term Use of Man's Environment and Maintenance and Enhancement of Long-Term Productivity

The quantities of energy required for project construction and operation are quite small on a regional and national context. The use of these resources now will not materially affect their availability for future use. No energy development or use options are foreclosed by the project.

**4.0**

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## **GLOSSARY**

## 4.0 GLOSSARY

### 4.1 Terms

Area of Concentrated Study: that portion of the Region of Influence which may experience important impacts (see Section 3.1).

Baseline: future trends in the absence of the Proposed Action.

British Thermal Unit (Btu): approximately the amount of heat required to raise the temperature of 1 pound of water by 1 Fahrenheit degree, at 60° F.

Degree-Day, Heating: a unit, based upon temperature difference and time, used in estimating fuel consumption and specifying nominal heating load of a building in winter. For any 1 day, when the mean temperature is less than 18.3 °C (65° F), there are as many degree-days as degrees Celsius (Fahrenheit) difference in temperature between the mean temperature for the day and 18.3°C (65° F).

Energy: the capacity for doing work; taking a number of forms which may be transformed from one into another, such as thermal (heat), mechanical (work), electrical, and chemical; in customary units, measured in kilowatt hours (kWh) or Btu.

"Firm" Power: that amount of electrical power (in kilowatts) that a wholesaler is contractually bound to supply to a retailer on demand.

Gasohol: a fuel mixture consisting of 10 percent ethyl alcohol and 90 percent gasoline; suitable for use in automobiles.

Long Term: the post-construction period, specifically 1990 and on.

"Nonfirm" Power: electric power supplied under a contract which makes available seasonally excess power (i.e., power in excess of contractually "firm" power) and is generally sold at a lower price than "firm" power. This type of contract may be offered by a generator with a large hydroelectric capacity which is subject to water shortages during periods of low precipitation.

Peak Demand: the highest instantaneous amount of electrical power (in kilowatts) that an electrical system is required to supply over a given time frame, usually 1 year.

Ratchet Charge: an additional unit charge that an electrical retailer must pay if peak demand or total consumption exceed specified contractual thresholds.

Region of Influence: that area where project-induced effects of any magnitude may be expected to occur.

Rural Electric Association (REA): cooperative sponsored by the Rural Electrification Administration of the U.S. Department of Agriculture to supply electricity to a rural area.

Short Term: the period of time during which the project is constructed, specifically 1984 through 1989.

Wheel: as an electrical term, the use of a third party's powerline to effect delivery of power from an electricity supplier to a consumer.

## 4.2 Acronyms

ACS	Area of Concentrated Study
AFB	Air Force Base
AFRCE-BMS	Air Force Regional Civil Engineer - Ballistic Missile Support
Cheyenne LF&P	Cheyenne Light, Fuel and Power Company
CIG	Colorado Interstate Gas Company
DA	Deployment Area
DOE	Department of Energy
ECIP	Energy Conservation Investment Program
ECPA	Energy Conservation and Production Act
EES	Energy Extension Service
EIS	Environmental Impact Statement
EPCA	Energy Policy and Conservation Act
EPTR	Environmental Planning Technical Report
FY	Fiscal Year
HDD	Heating Degree-Day
HVAC	Heating - Ventilating - Air Conditioning
K/N	Kansas/Nebraska Natural Gas Company, Inc.
LF	Launch Facility
LOI	Level of Impact
MEAN	Municipal Energy Agency of Nebraska
NEO	Nebraska Energy Office
NMPP	Nebraska Municipal Power Pool
NPPD	Nebraska Public Power District
PP&L	Pacific Power and Light Company
REA	Rural Electric Association
REC	Rural Electric Company
ROI	Region of Influence
SSA	Stage Storage Area
S/T	Stage Transporter
T/E	Transporter Erector
Tri-State	Tri-State Generation and Transmission Association
WAPA	Western Area Power Administration
WECO	Wyoming Energy Conservation Office

#### 4.3 Units of Measurement

bbl/day	barrels per day
BCF	billion cubic feet (natural gas)
Btu	British thermal unit
kV	kilovolt (thousand volts)
kVA	kilovolt ampere
kW	kilowatt (thousand of watts)
kWh	kilowatt hour
MCF	thousand cubic feet
MG	million gallons
MMB	million barrels
MMCF	million cubic feet
MW	megawatt (millions of watts)
MWh	megawatt hour

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## REFERENCES CITED AND REVIEWED

## 5.0 REFERENCES CITED AND REVIEWED AND PERSONAL COMMUNICATIONS

### 5.1 Documents

Bickett, Browne, Coddington and Associates  
1975 Wyoming Energy Consumption. Denver, Colorado.

Bureau of Land Management  
1981 Final EIS Energy Transportation Systems, Inc. (ETSI). Denver.

Cheyenne Light, Fuel and Power Company  
1982 Annual Report. Cheyenne, Wyoming.

Kansas/Nebraska Natural Gas Company, Inc.  
1982 Annual Report. Lakewood, Colorado.

Nebraska Department of Revenue  
1982 Annual Report. Lincoln.

Nebraska Department of Roads  
1983 Unpublished data on Annual Vehicle Miles, Lincoln.

Nebraska Energy Office  
1980 Annual Report. Lincoln.

Nebraska Energy Office  
1981 Annual Report. Lincoln.

Nebraska Energy Office  
1982 Annual Report. Lincoln.

Nebraska Energy Office  
1983 Nebraska Energy Conservation Plan. Lincoln.

Nebraska Energy Office  
1983a Energy Extension Service Plan. Lincoln.

Nebraska Energy Office  
1983b Institutional Conservation Program. Lincoln.

Nebraska Energy Office  
1983c Weatherization Assistance Plan. Lincoln.

Nebraska Municipal Power Pool  
1982 Annual Report. Lincoln.

Nebraska Public Power District  
1982 Annual Report. Columbus, Nebraska.

Pacific Power and Light Company  
1981 Annual Report. Portland, Oregon.

Tri-State Generation and Transmission Association, Inc.  
1981 Annual Report. Denver.

- U.S. Air Force  
1980 Air Force Energy Conservation and Management. Air Force Energy Office (LEYSF), Washington, DC.
- U.S. Air Force  
1981 Air Force Energy Plan. Air Force Energy Office (LEYSF), Washington, DC.
- U.S. Air Force  
1982 Energy Management Report. Air Force Energy Office (LEYSF), Washington, DC.
- U.S. Dept. of Energy  
1982a Natural Gas Annual 1981. Energy Information Administration, Washington, DC.
- U.S. Dept. of Energy  
1982b Outlook for U.S. Coal. Energy Information Administration, Washington, DC.
- U.S. Dept. of Energy  
1982c Synopsis of the Annual Energy Review and Outlook. Energy Information Administration, Washington, DC.
- U.S. Dept. of Energy  
1982d State Energy Data Report, 1960 through 1980. Energy Information Administration, Washington, DC.
- U.S. Dept. of Energy  
1983a Coal Distribution January - December 1982. Energy Information Administration, Washington, DC.
- U.S. Dept. of Energy  
1983b Report of the Electricity Policy Project: The Future of Electric Power America, Economic Supply for Economic Growth. Office of Policy, Planning and Analysis, Washington, DC.
- U.S. Dept. of Energy  
1983c Short-Term Energy Outlook. Energy Information Administration, Washington, DC.
- U.S. Rural Electrification Administration  
1976 Generating Units 1, 2, and 3, Associated Transmission Lines and Greyrocks Reservoir. Final EIS, Washington, DC.
- Western Area Power Administration  
1981 Annual Report. Golden, Colorado.
- Wyoming Department of Administration and Fiscal Control  
1981 Wyoming Data Handbook. Cheyenne.
- Wyoming Department of Economic Planning and Development  
1982 Mineral Development Monitoring System. Cheyenne.

Wyoming Department of Economic Planning and Development  
1982 Wyoming Mineral Yearbook. Cheyenne.

Wyoming Department of Revenue and Taxation  
1979 Annual Report. Cheyenne.

Wyoming Department of Revenue and Taxation  
1980 Annual Report. Cheyenne.

Wyoming Department of Revenue and Taxation  
1981 Annual Report. Cheyenne.

Wyoming Department of Revenue and Taxation  
1982 Annual Report. Cheyenne.

Wyoming Energy Conservation Office  
1983 Energy Extension State Plan. Cheyenne.

Wyoming Energy Conservation Office  
1981 A History of the Wyoming Energy Conservation Office. Cheyenne.

Wyoming Highway Department  
1982 Unpublished data on Annual Vehicle Miles, Cheyenne.

Wyoming State Planning Coordinators Office  
1977 Wyoming Energy Conservation Plan. Cheyenne.

## 5.2 Personal Communications

Cheyenne Light, Fuel and Power Company  
1983 Personal communication with Operations Manager, Cheyenne, Wyoming,  
June 17.

Cheyenne-Laramie County Regional Planning Office  
1983 Personal communication with staff, Cheyenne, Wyoming, July 1.

Chugwater, Town of  
1983 Personal communication with Town Councilman, Chugwater, Wyoming,  
November 21.

Colorado Interstate Gas Company  
1983 Personal communication with staff, Colorado Springs, Colorado,  
July 21.

Energy and Environmental Analysis, Inc.  
1983 Personal communication with staff, Arlington, Virginia, October 12.

F.E. Warren AFB  
1983 Personal communication with Chief Missile Engineer, Cheyenne,  
June 14.

F.E. Warren AFB Civil Engineering Office  
1983 Personal communication with staff, Cheyenne, June 14.

F.E. Warren AFB Fuel Allocation Office  
1983 Personal communication with staff, Cheyenne, June 14.

Fleischli Oil Company  
1983 Personal communication with the President, Cheyenne, June 17.

Fort Collins Light and Power Company  
1983 Personal communication with staff, Fort Collins, Colorado, July 20.

Gering Electric Department  
1983 Personal communication with the Manager, Gering, Nebraska, June 29.

Greeley Gas Company  
1983 Personal communication with the Operations Manager, Greeley, Colorado, July 19.

Home Power and Light Company  
1983 Personal communication with the Operations Manager, Greeley, Colorado, July 19.

Husky Oil Refinery  
1983 Personal communication with with the Manager, Cheyenne, June 28.

Kansas/Nebraska Natural Gas Company, Inc.  
1983 Personal communication with the Vice-President of Operations, Hastings, Nebraska, July 18.

Kimball, City of  
1983 Personal communication with the City Administrator, Nebraska, June 30.

Nebraska Department of Revenue  
1983 Personal communication with staff, Lincoln.

Nebraska Energy Office  
1983 Personal communication with the Deputy Director, Lincoln, July 6.

Nebraska Public Power District  
1983 Personal communication with the Western Regional Manager, Scottsbluff, Nebraska, June 29.

Nebraska Public Service Commission  
1983 Personal communication with the Executive Secretary, Lincoln, July 5.

Northern Gas Company  
1983 Personal communication with the Manager, Laramie, Wyoming, July 28.

Pacific Power and Light Company  
1983 Personal communication with the Vice-President, Portland, Oregon, July 1.

Pine Bluffs, City of  
1983 Personal communication with the City Clerk, Wyoming, August 1.

Pine Bluffs, City of  
1983 Personal communication with staff, Pine Bluffs, Wyoming, November 22.

Public Service Company of Fort Collins  
1983 Personal communication with the Engineering Department, Fort Collins, Colorado, July 19.

Rural Electric Company  
1983 Personal communication with the Manager, Pine Bluffs, Wyoming, June 16.

Torrington, City of  
1983 Personal communication with a Consultant to the City, Wyoming, July 15.

Torrington Electric Department  
1983 Personal communication with the Manager, Wyoming, July 1.

Western Area Power Administration  
1983 Personal communication with the Director, Golden, Colorado, June 17.

Wheatland, City of  
1983 Personal communication with the City Clerk, Wyoming, July 18.

Wheatland Rural Electric Association  
1983 Personal communication with the Foreman, Wyoming, June 16.

Wyoming Department of Economic Planning and Development  
1983 Personal communication with the staff, Cheyenne, June 28.

Wyoming Energy Conservation Office  
1983 Personal communication with the Director, Cheyenne, June 17.

Wyoming Municipal Power Agency  
1983 Personal communication with staff, Lusk, Wyoming, December 2.

Wyoming Public Services Commission, Utilities Department  
1983 Personal communication with the Director, Cheyenne, June 14.

Wyrulec Electric Company  
1983 Personal communication with the Foreman, Lingle, Wyoming, June 16.

Wyrulec Electric Company  
1983 Personal communication with the Manager, Lingle, Wyoming, June 22.

**6.0**

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## APPENDIX A

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APPENDIX A  
LITERATURE REVIEW OF ENERGY EFFICIENCY  
REQUIREMENTS IN LOCAL BUILDING CODES

This report is the result of an investigation into energy and building codes of selected cities and states with energy conservation measures which go beyond typical or mandated codes such as those that follow American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) 90-75 or 90-80A Standards. ASHRAE describes recommended minimum energy conservation features (Table A-1). In most cases, energy conservation standards have been targeted toward not only residential construction, but also toward commercial structures. This analysis addresses only those codes and standards that apply to new residential structures.

An important consideration in amending a building or energy code is whether to adopt prescriptive or performance standards. Prescriptive standards are the simplest to formulate, implement, and enforce. Such standards prescribe minimum levels of conservation achievement and minimum measures for the kinds of material to be used in various parts of the structure, i.e., the ratio of the window area to the outside of the building, how much and what type of insulation is needed in different parts, and so on. Prescriptive ordinances are effective for conventional housing, where design and materials are fairly standard. In addition, they are easy to enforce because they require a minimum amount of judgment in evaluating a proposed building's consistency with the code's requirements. The disadvantages of prescriptive codes are that they tend to discourage innovative design solutions to energy problems.

Performance standards, on the other hand, set general criteria to be met by the building as a whole (usually in terms of a maximum heat gain or loss of a building expressed in Btu per square foot of floor area). It is then left up to the builder or architect to determine the method for compliance with the overall standards. Performance codes are generally more complex than prescriptive codes, since an extensive dialogue between builder and building inspector is required to identify building consistency. However, performance standards allow for greater opportunity for innovative and more energy-efficient design.

To accommodate the needs and concerns of all builders, many building or energy codes include both prescriptive and performance standard options. Under this arrangement, applicants may choose which path they wish to follow based on individual goals and experience.

To illustrate different approaches to stringent building codes, several examples are discussed and their major features are identified. Where available, estimates of energy savings that have resulted or are projected to result from adoption and implementation of these energy conservation codes or measures are included. In addition, recent studies which generally analyze energy efficiency and conservation standards, their possible savings, and the cost-effectiveness of adoption are referenced.

TABLE A-1  
ENERGY CONSERVATION STANDARDS - NEW RESIDENTIAL CONSTRUCTION

Components	ASBRAE 90-80A Standards (Heating Degree Days - 7300, Cheyenne, Wyoming)		Seattle (4815 Heating Degree Days) Low-Rise Residential		Northwest Power Planning Council - Climate Zone 3 (Typical R20-8000) Recommended Prescriptive Standards	
	Type A-1 Building	Type A-2 Buildings	Performance	Prescriptive	Single-Family	Multi-Family
INSULATION MINIMUMS						
Ceiling/Roof Wall	.036 .165	.036 .25	.03 .2	.03 U Values (Total wall) (opaque wall only)	R-30 R-31	R-30 R-25
Raised Floor Slab on Grade (heated)	.08	.08	.08		R-30	R-30
Door - exterior	R-8	R-8	6.35	6.35 R Values	R-15 R-13	R-15 R-13
AIR INFILTRATION RATES						
Doors-entrance Windows	.5 " .5 "	.5 " .5 "	1.00" .5%	1.00" .5%	---	---
OVERALL THERMAL PERFORMANCE						
	None	None	Overall heat gain or loss for building cannot exceed the total resulting from the conformance to the stated U values.		3.2 kWh per sq.ft. per year .3 AC/HIP <sup>a</sup>	2.8 kWh per sq.ft. per year .3 AC/HIP <sup>a</sup>
INFILTRATION CONTROL MEASURES	Exterior joints in the building envelope that are sources of air leakage such as around window and door frames, between wall cavities and window or door frames, between wall and foundation, between wall and roof, between wall panels, at penetrating or utility services through walls, floors and roofs shall be caulked, gasketed, weatherstripped, or otherwise sealed.		All openings in the building envelope shall be sealed, caulked, gasketed or weatherstripped. All exterior doors shall be designed to limit air leakage around their perimeter. Vapor barriers.		Sealing in flues, vents, ducts, walls and ceilings. Windows shall be sealed type or casement or awning. Possible air to air heat exchanger requirement. Dehumidifiers. Continuous infiltration barrier.	
SPACE CONDITIONING SIZING	Variable Methods		125% of design load.		to specific requirement.	
GLAZING REQUIREMENTS	None	None	Maximum of 21% of gross exterior wall area.		15% - total area 10% - total non-southfacing area	---
EXCEPTIONS FOR PASSIVE SOLAR	None	None	Yes	Yes	Yes	Yes

<sup>a</sup> Cubic feet per minute per square foot of door area.  
<sup>aa</sup> Cubic feet per minute per linear foot of questionable sash crack.

<sup>a</sup> AC/HIP - Air Changes per hour, measured in air volume.

**TABLE A-1 CONTINUED**  
**ENERGY CONSERVATION STANDARDS - NEW RESIDENTIAL CONSTRUCTION**

Components	State of California - Climate Zone 16 (Average HDD-5300) Residential Under Four Stories				Davis, California (2800 HDD) Low-Rise Residential	State of Minnesota (Average HDD-8300) Low-Rise Residential	
	Mandatory	Package A	Package B	Package C	Mandatory Measures Only	Type A-1 Building	Type A-2 Buildings
INSULATION MINIMUMS Ceiling/Roof Wall	R-19 R-11	R-38 R-19 (R-9.5)*	R-38 R-19 (R-7)*	R-30 R-19 (R-7.5)*	R-19 R-11	.026 .11 (total wall) U values .225 (total wall)	.033 .225 (total wall)
	--	R-19	R-19	R-19	--	.05	.08
	--	R-7	R-7	R-7	--	R-9 R values R-3	R-9 R values R-3
	--	--	--	--	--		
	--	.65 B value	.65 B value	.65 B value	--	1.00* .5**	1.00* .5**
OVERALL THERMAL PERFORMANCE	Energy Budgets - (Space Conditioning Only)	Single-Family Detached - 8.7 kwh/sq. ft. per year Single-Family Attached - 7.5 kwh/sq. ft. per year Multi-Family - 7.8 kwh/sq. ft. per year			Maximum annual energy usage - (space conditioning) Single-family - 31,900 Btu's/sq. ft. Multi-family - 24,100 Btu's/sq. ft.	None	None
INFILTRATION CONTROL MEASURES	All openings in the building envelope shall be sealed, caulked or weatherstripped. Vapor barrier.	Same as mandatory	Same as mandatory plus continuous infiltration barrier.	Same as mandatory	Full weatherstripping of doors and windows. Caulking and sealing of all openings in the building envelope.	Full weatherstripping of doors and windows. Caulking and sealing of all openings in the building envelope. Continuous vapor barrier.	
SPACE CONDITIONING SIZING	Total output capacity of furnaces must be less than 45,000 Btu/hr.	Same	Same	Same	Total output heating capacity shall be less than 45,000 Btu/hr.	115% of design load for space heating.	
GLAZING REQUIRE- MENTS	--	--	16% - total area	16% - total area	--	12% of the gross area of exterior walls.	
EXIGENCIES FOR PASSIVE SOLAR	No	Yes	M/A	M/A	Yes	Yes.	
* B value in parenthesis is for the entire wall assembly if the wall weight exceeds 40 pounds per sq. ft.							
* Cubic feet per minute per square foot of door area. ** Cubic feet per lineal foot of operable sash crack.							

## A.1 Seattle - City Code

The Seattle Energy Code, adopted in February 1980, provides minimum standards for new buildings to achieve more efficient energy utilization. The code permits the use of alternative methods and innovative approaches and techniques to achieve its purposes. It also encourages the use of solar and other new technologies which may result in future energy efficiency and increased use of renewable energy sources.

The Seattle Code establishes design criteria in terms of both performance and prescriptive requirements for new residential construction (Table A-1). Overall, the code's thermal performance criteria, particularly the minimum insulation levels and exemptions for passive solar features, are more stringent than ASHRAE standards. Thermal performance is defined by the overall heat gain or loss for the entire building envelope. Such criteria have been developed to conform to western Washington climatic conditions (approximately 4,800 heating degree-days). These conditions are significantly different than weather conditions in eastern Wyoming, with heating degree-days generally around 7,300; therefore, Seattle standards may not be directly applicable to Wyoming residential construction.

To date, there has been no analysis or evaluation of the Seattle Energy Code in terms of the energy savings that result from the adopted measures. The cost-effectiveness of mandating such measures in Seattle has not been substantiated.

## A.2 Northwest Regional Standards

As part of the 1983 Regional Conservation and Electric Power Plan, the Northwest Power Planning Council has adopted efficiency standards for new residential buildings. These standards are part of an overall Northwest Power Planning Council energy code, Model Standards for New Construction. New building codes which contain the efficiency standards (or an alternative plan to achieve comparable savings) must be adopted by states, local governments, or utilities by January 1, 1986. The Council has the authority to impose a 10 to 50-percent surcharge on Bonneville Power Administration power sold to utilities serving noncomplying jurisdictions.

Standards have been developed for three different climate zones. It was assumed in this report that Climate Zone 3, which covers western Montana, is most similar to conditions in eastern Wyoming. The overall purpose of the efficiency standards is to establish cost-effective performance levels for space heating requirements in new single and multifamily dwellings. The standards for new residential buildings specify only the maximum electric energy use permitted for space heating in a new building. It allows the designers and builders to select any means to achieve the specified energy-use budget. These maximum levels of 3.2 and 2.8 kWh/sq ft/yr, respectively, for single and multifamily, are reflected in Table A-1, as are recommended prescriptive standards and approaches for achieving the performance levels. Such standards go well beyond the standards outlined in ASHRAE 90-75 and 90-80A. Recommended insulation minimums, glazing requirements, and infiltration standards are generally more stringent than those typically found in energy or building codes in both the northwest and throughout the country. It should be noted that other methods are available to satisfy the performance level requirements.

The Council conducted an extensive assessment of the energy savings potential available through adoption of thermal efficiency standards. Tables A-2 and A-3 contain estimates of the cost and savings on a measure-by-measure basis for new single and multifamily dwellings, respectively. The savings estimates are based on a computer simulation of the annual electric space heating energy use of new dwellings, assuming no wood heating and an average 24 hour per day thermostat setting of 65°F. The cost estimates are given in 1980 dollars. According to Council estimates, the adoption of the model standards could reduce the current regional average energy use per new unit (estimated at approximately 7,500 kWh for electric space heating) by approximately 60 percent for all 3 climate zones.

Again, the applicability of the Council's specific standards, and the estimated savings potential to new residential construction in Wyoming, is somewhat uncertain. The actual cost-effectiveness of mandating the Council's efficiency standards has yet to be tested in the real housing market. In addition, the availability and price of energy and weather conditions do vary between the Council's climate zones and eastern Wyoming. Such factors must be considered during formulation of specific thermal efficiency standards.

### A.3 California - State Code

Energy efficiency standards for residential buildings (Title 24) went into effect in California in 1978. According to the California Energy Commission (CEC), Title 24 requirements resulted in a 50-percent reduction in energy use in new residences built between 1978 and 1981, compared to those built prior to 1975. Due to continued energy price increases and the need to make the standard more flexible, the Commission adopted revised energy standards for new residential buildings in July 1982.

The new Title 24 standards are prescriptive or performance standards augmented with certain mandatory measures. The state is divided into 16 different climate zones, and separate energy budgets are assigned for single-family detached, single-family attached, and multifamily structures. Each budget has two components: the annual amount of Btu expended per square foot for space conditioning and the annual amount of Btu expended for water heating. The standards allow for tradeoffs among and between space conditioning and water components.

To obtain a building permit, the applicant must first show compliance with a list of conservation requirements applicable to all new residential buildings, regardless of the approach used. Then, the applicant must show compliance with the energy budget requirements using one of the following methods:

- o A prescriptive method in which a fixed list of measures, predetermined to meet the budgets, must be installed.
- o A performance method in which the builder uses any of the approved calculation methods to determine whether the design and materials chosen by the builder will meet the energy budget.

Compliance with the energy budget may be achieved by installing one of three alternative component packages, as part of the prescriptive method. Package A, the passive solar approach, requires proper solar orientation, appropriate

Table A-2  
NORTHWEST POWER PLANNING COUNCIL ESTIMATES FOR  
SAVINGS IN NEW SINGLE-FAMILY STRUCTURES

Measure	Unit Cost 1980 \$	Life Years	Climate Zone <sup>1</sup>		
			1	2	3
Insulate Roof (R values)					
R19 to R30	176	30	729	1,097	1,266
R30 to R38	128	30	239	363	427
R38 to R49	176	30	156	262	313
R49 to R60	176	30	106	179	215
Infiltration (AC/HR) <sup>2</sup>					
.6-.4	381	30	1,096	1,650	1,927
.4-.2	635	30	941	1,471	1,745
Insulate Floors					
R11 to R19	200	30	422	637	750
R19 to R30	301	30	290	480	571
R30 to R42	652	30	171	312	380
Insulate Glass (Panels)					
1-2	302	30	2,046	3,005	3,499
2-3	346	30	584	875	1,046
3-4	495	30	200	347	419
Insulate					
R11 to R19	203	30	860	1,284	1,480
R19 to R27	213	30	365	554	653
R27 to R31	81	30	127	190	229
R31 to R38	569	30	72	136	168
Doors					
R2 to R13	87	30	474	702	814

Notes: 1 Energy savings in kWh/yr.

2 Air changes/hour measured in air volume.

Source: Northwest Power Planning Council, 1983.

Table A-3

NORTHWEST POWER PLANNING COUNCIL ESTIMATES FOR  
SAVINGS IN NEW MULTIFAMILY STRUCTURES

Measure	Unit Cost 1980 \$	Life Years	Climate Zone <sup>1</sup>		
			1	2	3
Insulate Roof (R values)					
R19 to R30	42	30	108	167	194
R30 to R38	30	30	32	54	64
Infiltration (AC/HR) <sup>2</sup>					
.6-.4	340	30	751	1,178	1,374
Insulate Floors					
R11 to R19	47	30	184	282	327
R19 to R30	71	30	82	138	164
R30 to R38	189	30	30	51	60
Insulate Glass (Panes)					
1-2	196	30	1,252	1,907	2,199
2-3	225	30	336	538	639
3-4	724	30	131	233	276
Insulate					
R11 to R19	91	30	331	510	592
R19 to R27	95	30	157	248	293
R27 to R38	290	30	80	139	165
Doors					
R2 to R13	23	30	131	201	232

Notes: 1 Energy savings in kWh/yr.

2 Air changes/hour measured in air volume.

Source: Northwest Power Planning Council 1983.

levels of thermal mass (storage), south facing windows, and moderate insulation levels. Package B generally requires higher levels of insulation than Package A, but has no thermal mass or window orientation requirements. Package C is also with passive solar design but requires active solar water heating in exchange for less stringent insulation and/or glazing requirements.

Two additional approaches for complying with the energy budget also exist as part of the performance method. The Simplified Calculation Method assigns positive or negative points to a wide variety of conservation measures, based on the amount of energy saved or used by the measure. By choosing a design and selecting various measures, a builder can accumulate sufficient points to meet the energy budget. Under the Computer Performance Method, a Commission-certified energy analysis computer program is used to determine a building's annual energy consumption.

For purposes of this report, standards applicable to Climate Zone 16 are presented. This zone generally covers the extreme northern and northeastern portion of California and has heating degree-days which average approximately 5,300. Mandatory measures and alternative component packages under the prescriptive method are outlined in Table A-1. The Simplified Calculation and Computer Performance methods allow a great deal of flexibility in meeting energy budgets; therefore, it is impossible to represent energy measures that would be installed if a builder chooses these methods.

According to the California Energy Commission (CEC), by the year 2000, the adopted standards for all climate zones will reduce the need for new generation facilities and save several hundred million barrels of oil. Net dollar savings to residents of new buildings will range from \$8,000 to \$17,000 over a 30-year period. In developing the standards, the CEC used a lowest life-cycle cost approach in appraising cost effectiveness, selecting the most cost-effective measures first and setting standards at the point of minimal life-cycle cost. Detailed measure-by-measure energy savings estimates were not available at the time of this writing. Due to the difference in weather conditions between the ROI and Climate Zone 16, as well as divergent energy prices and supply conditions, the applicability of the specific CEC standards to new residential construction is questionable. However, the overall format and approach taken by the CEC may certainly be valid for other parts of the country.

#### A.4 Davis, California - Energy Building Code

The City of Davis developed its own local energy conservation performance standards for residential construction in January 1976. These local standards diverge from ASHRAE standards and contain both prescriptive and performance standards. Therefore, a developer may choose to comply with either specific thermal design requirements or thermal performance standards requiring energy budget calculations but allowing design flexibility.

The Davis standards were designed to be responsive to the local weather conditions (approximately 2,800 heating degree-days), in an attempt to conserve additional amounts of energy. Requirements for shading and orientation of glazing were developed specifically for the Davis climate, as were the maximum allowable window area, and standards for roof and wall color and cross-ventilation. Standards emphasized the thermal storage capacity of physical mass in a building.

As mentioned in the preceding section, the State of California adopted revised energy conservation standards in July 1982 as part of Title 24. It was determined by the City of Davis that the State regulations were inadequate for use in Davis due primarily to the unique characteristics of the Davis climate (hot summers and cool winters). Therefore, the City adopted its own amendments in June 1982, so that energy savings resulting from a revised code will exceed those required by the State. The new Davis Code contains mandatory features that must be installed in or on all new residential buildings. These mandatory measures are presented in Table A-1. As stated, several methods exist for complying with the overall performance standards. Such methods are similar to the methods discussed under the State of California Code, with more stringent requirements for glazing orientation, cross-ventilation, and roof and wall colors.

While an analysis of the energy savings that have or will accrue from the revised code has not been undertaken as of yet, a study of the original Davis Energy Conservation Standards was completed in 1979. A detailed comparison was made of energy use in certain homes built in Davis by a local builder, both prior to the Davis standards and after the adoption of the standards, primarily between 1975 and 1978. Results of the analysis indicated that the average annual energy use per square foot was reduced by between 8 and 16 percent. Summer electricity demands and winter natural gas demands were reduced by 7 and 20 percent, respectively. Certain factors, however, were not individually analyzed in the study, including average family size, average income, and energy use behavior changes.

Again, it should be noted that the applicability of the specific Davis standards to eastern Wyoming and western Nebraska is highly questionable due to the extreme difference in weather conditions. However, the emphasis on developing standards that are specifically geared toward the local climate and the format and approach of the Davis Code are worth further review prior to formulation of thermal efficiency standards.

#### A.5 Minnesota - State Code

The State of Minnesota recently proposed amendments to the State Building Code concerning energy efficiency standards. The code sets forth minimum requirements for the design and evaluation of new and remodeled elements of buildings, by regulating their exterior envelopes and the selection of heating systems and energy equipment. The new code is intended to incorporate the Model Energy Code, published by the Council of American Building Officials, with certain amendments.

The proposed provisions for regulating the design of building envelopes for adequate thermal resistance are presented in Table A-1. Such provisions apply to single-family (type A-1) dwellings and low-rise multifamily dwellings, motels, and other group residences (type A-2). The new code is geared toward residential development in a relatively cold, harsh climate, with annual heating degree-days over 8,000. Its applicability to new residential construction in eastern Wyoming and western Nebraska may be more valid than the codes previously discussed in this report. However, in general, the Minnesota Code is not as stringent as the other codes, relative to climatic conditions. Analysis and evaluation of the energy savings that will result

from the proposed requirements was not available for review at the time of this writing.

Other recent, related studies are summarized below.

#### General Studies:

- A. Thermal Efficiency Standards and Codes, Vol.1, State of the Art Literature Review and Analysis of Secondary Data by N.E. Collins, L.N. McCold, and P. Zuschneid, prepared by the Oak Ridge National Laboratory, Oak Ridge, Tennessee, June 1983.

This study estimates the impacts of mandated thermal efficiency standards (ASHRAE 90-75) on construction practices by 1) reviewing the standard methodology developed by the U.S. Department of Energy for the dual purpose of estimating planned savings and calculating actual annual savings, correcting data errors, and adding factors such as compliance with standards; 2) analyzing state legislation to determine date of code/standard adoption, date of implementation, types of buildings covered, and stringency of the code administration process; and 3) examining the correlations between measures of code compliance, the code characteristics described above, and such external variables as climate, fuel prices, and state demographics.

Among the conclusions drawn from this study are that: 1) reported energy savings by states were overestimated due solely to inaccurate construction rates and energy consumption figures; 2) as of January 1, 1982, only 27 states had codes which fully met federal requirements (ASHRAE 90-75 at a minimum) and 7 states had no effective codes in place which even partially met requirements; and 3) no significant correlations were found between existence, age, or characteristics of a code/standard and improved construction practices or compliance with ASHRAE insulation requirements.

Study conclusions appear significant, especially as they relate to correlations of code characteristics and actual compliance. However, the study contains several limitations including analysis of only ASHRAE 90-75 standards, analysis of only state codes and standards, and the fact that the bulk of the research was conducted prior to 1981. The majority of the more stringent local and state codes (those that go beyond ASHRAE 90-75 and 90-80A) were adopted subsequent to this research, and have been in effect for only a short period of time. Further analysis of these codes may alter study conclusions.

- B. Energy Efficient Housing Construction by Canadian Mortgage and Housing Corporation, 1982.

This study discusses the so-called "new-generation" of housing construction in Canada "the super energy-efficient or super-insulated" home. It provides an introduction into the principles and practices of energy efficient housing construction and presents actual construction details to accomplish energy efficiency. While it does not speak directly to building or energy codes, it does provide recommendations of specific energy conservation measures and standards applicable to three different climate zones in Canada (Table A-4). Since climate conditions in Zone C are somewhat similar to such conditions in eastern Wyoming and western Nebraska, an analysis and review of this study may

be valuable. It should be noted, however, that the cost-effectiveness of recommended measures was not taken into consideration in the study.

Table A-4

APPROPRIATE ENERGY-EFFICIENT INSULATION  
LEVELS FOR ZONE C (6,500 HEATING DEGREE-DAYS)

<u>Component</u>	<u>R Value</u>
1) Ceilings	60
2) Walls	39
3) Foundation Walls (50% or more below grade)	22
4) Exposed Floors (raised)	27
5) Slabs on Grade	22
6) Basement Floors	10

- C. Future Energy Savings in U.S. Housing by Robert H. Williams and Gautam S. Dutt, Center for Energy and Environmental Studies, Princeton University, Princeton, New Jersey, March 1983.

This report, prepared in conjunction with the American Council for an Energy Efficient Economy, analyzes cost-effective technologies for improving energy efficiency in housing. Alternative space heating options and improvements are compared to determine achievable cost savings. Super-insulated homes are evaluated in terms of relative performance in various climates. Specific studies of homes built in Minnesota and New England are referenced and major conclusions are discussed. Recommendations are made concerning possible methods for formulating public policies to facilitate the use of cost-effective technologies.

- D. Building to Save Energy - Legal and Regulatory Approaches by Grant P. Thompson, Ballinger Publishing Company, Cambridge, Massachusetts, 1980.

This book, which examines legal and administrative strategies that states and localities can use to promote energy conservation in buildings, also features an analysis of strategies for improving a building envelope's resistance to heat transmission. It contains an evaluation of ASHRAE 90-75 standards and other federal performance standards. Chapter 3 explains the national codes that were in the process of being developed at the time, so that more rational choices could be made by states and localities considering whether to adopt one of the codes or try to formulate a more stringent code.

Specific legal and regulatory strategies are outlined to improve a building's resistance to heat transmission. It evaluates both existing and proposed strategies for their technical and economic soundness. Such strategies for

new residences include educational efforts (advertising, information dissemination), economic incentives (tax credits, cash refunds), direct regulation (building code), and public utility commission regulations (minimum standards in service areas). Specific strategies for existing residences and nonresidential buildings are also evaluated.

E. 1980 Federal and State Actions in Energy Codes, Standards, Legislation and Regulations by the National Conference of States on Building Codes and Standards, January 1981.

This report presents an overview of current practice in the energy code field. It provides an assessment of governmental action as it relates to the formulation of standards and regulations to promote energy efficiency in new construction.

F. Other relevant reports include:

- o Energy Conservation: State Legislature Activities, a paper presented at the ASHRAE semiannual meeting by David R. Conover, January 1982.
- o Energy Efficiency in Buildings: A State Policy Handbook, published by the National Conference of State Legislatures, 1982.
- o Comparison of 1979 Residential Design Practices to Applicable Energy Conservation Code Requirements, published by the National Institute of Building Sciences, Washington, DC, December 1980.
- o Measured Thermal Performance and the Cost of Conservation for a Group of Energy Efficient Minnesota Homes by M. Hutchinson, M. Fageron, and G. Nelson, Energy Information Center, New York, NY, 1982.
- o Research and Innovation in the Building Regulating Process, published by the National Bureau of Standards, Washington, DC, 1978.
- o The California Experience with Energy Conservation Standards for Buildings by Robert Feinbaum, Lawrence Berkeley Laboratory, Berkeley, California, May 1981.